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Methods of Russia's Kurchatov Institute Studied for Recording and Processing Transmission Holograms

964D0463A St. Petersburg OPTIKA I
SPEKTROKOPIYA in Russian Dec 95
No 6 pp 1014-1017

[Article by A.G. Petrashen, V.N. Rebane, and T.K. Rebane, St. Petersburg State University. 198904 St. Petersburg, Russia; UDC 539.186.3]

[FBIS Summary] Materials developed in the Russian Scientific Center (RSC) "Kurchatov Institute" were examined to determine the feasibility of transmitting holograms and holographic optical elements. Two types of developers and several bleaching processes were employed. The relationship of the diffraction efficiency as a function of exposition and the energy noise spectrum was used as a criterion of the recording quality. The materials and their processing procedures were effectively evaluated based on the sensitivity to the holographic recording, brightness of the reconstructed image, signal-to-noise ratio and maximum possible volume of recorded information. The maximum diffraction efficiency, obtained with the tests, was 58 percent. The results demonstrated that the materials can be used for recording the transmitting holograms when a high diffraction efficiency and a low noise level are required. In some cases these materials can replace bichromate gelatin. Because of a wide range of spectral sensitization, these materials can be employed in unique situations. Tables listing best values of the diffraction efficiency of some processes and best values of signal-

to-noise ratio, as well as curves of the diffraction efficiency are provided. Figures 4, references 6: 4 Russian, 2 Western.

Russia: Quadrature Electrooptic Effect Improves Recording, Reconstructing Electronic Images

964D0463B St. Petersburg OPTIKA I
SPEKTROKOPIYA in Russian Dec 95
No 6 pp 1018-1025

[Article by A.A. Berezhnoy, Vavilov State Optical Institute, St. Petersburg, Russia; UDC 548.0:537;548.0:535]

[FBIS Summary] The feasibility of increasing the efficiency of electrooptic methods for recording electronic images by employing a quadrature electrooptic effect is demonstrated. Use of materials capable of changing their index of refraction under impact of electric fields of electron images on their surface as a way to qualitatively improve sensitivity and increase the optical spectral range of recorded images is discussed. Characteristics, which determine the efficiency of recording procedures on plates of a transparent ferroelectric ceramics and lead magnoniobate $\text{PbMg}_{1/3}\text{Nb}_{2/3}\text{O}_3$ (PMN) monocrystals as a function of spatial frequency of the electron charges grating and its angular orientation are also discussed. The feasibility of increasing the recording efficiency with a decreased plate thickness of the electrooptic material is demonstrated. Figures 2, table 1, references: 7 Russian.

Moscow-Novosibirsk Fiber-Optic Link Planned

96P50079 Moscow VESTNIK SVYAZI in Russian
Oct 95 No 10, p 15

[FBIS Translated Text] The State Commission for Electrical Communications has reviewed technical and economic estimates for the construction of a fiber-optic communications link between Moscow and Novosibirsk.

Over a significant segment of this 1680-km line, 8-strand fiber-optic cable and a STM-16 high-speed transmission system are employed. This routes the flow of southbound international traffic (via Palermo and Istanbul) to international telephone exchanges in Aksay, Moscow, St. Petersburg, Samara, Yekaterinburg, and Novosibirsk as well as the flow of transit traffic from Western Europe to the countries of East Asia. The link's throughput rate makes it possible to resolve problems associated with the digitization of the national network, thereby increasing the volume and quality of international communications.

The Commission acknowledges the technical and economic estimates for the construction of the fiber-optic communications link as correct and generally valid, having drawn the attention of the appropriate planning facilities upon the inadequate handling of issues concerning provision for the viability of the fiber-optic communications link under external conditions, mutual redundancy with respect to the communications lines of other institutions and other corporate bodies (the Ministry of Railways, the Russian joint-stock company 'EEHS Rossii,' etc.), and the issue of the completion of the construction of a network node in the Trans-Don region.

The Commission's resolution envisioned the switchover of southbound lines of communication, traversing Ukrainian territory, to the Moscow-Novosibirsk fiber-optic communications link. The planning authorities in charge during the design and construction of southbound communications links should consider mutual coordination with the Moscow-Novosibirsk fiber-optic link.

Ukraine: INFOCOM Offering American Satellite-Based Telecom Services

964D0678A Kiev NARODNA ARMIYA in Russian
13 Mar 96 p 7

[Unattributed advertisement based on INFOCOM and EUROINDEX materials: "State-of-the Art Satellite Communication Technologies"]

[FBIS Translated Text] Several decades ago, when satellite communication was just starting to develop, henge antennas the size of five-story buildings were built

throughout the world. They were broadly touted as the state of the art with respect to science and technology, which may be why many people still associate satellite communication with the gigantic reflectors of parabolic antennas.

But, during the last decade, owing to the swift development of electronics and space technologies, satellite communication also underwent fundamental change. Without loading your attention down with unnecessary technical details, our desire is to talk about new satellite communications possibilities in support of management. To this end, INFOCOM is offering satellite communication stations and networks that will provide one, as their owner, access to developed international networks, permitting one to exchange information with the whole world. In addition one will be able to create one's own satellite communication network that is independent of land-based communications.

VSAT satellite communication stations are attracting the greatest interest today. They allow the establishment of both data transmission and channels for telephone communication with Europe, America and Africa.

The abbreviation VSAT (very small aperture terminal) is applied to satellite communication stations having antennas with diameters ranging from 0.9 m to 2.4 m. However, VSAT satellite communication networks are characterized not only by antenna size but also by the way in which one user's access to another is set up. Here, the analogy with computer data transmission networks, in which one of the more powerful computers plays the managing role in the network (that is, the server), is particularly apt. In a satellite communications network this role is played by a central or, as it is usually called, a hub station (in English, a switchboard). It is equipped with an antenna having substantially large dimensions (usually 6-9 m), a more powerful transceiver, and a powerful computer enabling communications within the network. Peripheral user stations, which consist of two parts—a small antenna with a diameter ranging from 1.2 m to 2.4 m and an internal module the size of a personal computer—are sequentially polled by the hub station, and an appropriate communications channel is established as needed.

Let us examine the most typical example—communication with Europe. The need for it arises in connection with the absence of normal communications over general-purpose channels, a circumstance which is nowadays typical even of Kiev, not to mention other regions of the Ukraine. Moreover, in an entire series of cases, when the demand for communication is sufficiently large, exceeding an average of 1-2 hours a day, ownership of one's own satellite-based telephone

channel becomes economically more advantageous. Finally, high-quality satellite channels with a minimum amount of switching are preferable to telephone channels when it comes to establishing communication with Western information networks. And so, for establishing communication with Europe, one should obtain a VSAT station and set it up on the roof of a building or within proximity of that place where one plans to install a telephone, computer, facsimile device, mini-PBX, etc. We hasten to stress the fact that the equipment should be purchased only from a firm possessing the right to offer operator services. For example, the firm INFOCOM-SK, which has a license from the Ukrainian Ministry of Communications for the design, installation, and servicing of satellite communications systems, and which is also an authorized distributor for America's Hughes Network Systems (HNS), can interconnect its users' stations with Western general-purpose telecommunications networks, via a hub—a centralized ground station.

Let us assume that a hub located in Berlin is chosen. Then, when someone calls from one's firm, the user will be connected by satellite to this centralized station, which has access to the general-purpose terrestrial telephone network. From there, still via terrestrial channels, the user is interconnected with users in Europe, the USA (via trans-Atlantic cable) and Asia—with those regions with which Berlin has normal communications over ground-based channels. (The operating firm has at its disposal information on the regions with which it communicates).

The per-minute rate for a telephone conversation plays a significant role in the choice of the location of the hub. If the customer needs to communicate more frequently with a particular country, it is better to seek out operators associated with an in-country hub station. The cost of the satellite channel would remain almost the same in this case, and there would be significantly less need to pay for ground-based channels.

When the number of calls is sufficiently large, it would be more preferable to lease a communication channel for a month or more. Thus, if the monthly cost of the satellite channel is on the order of DM18,000 a call load averaging four hours a day over a 25-day period would work out to DM180 for an hour of calls, and DM3 for a minute. When a channel is leased on a long-term basis, its cost can diminish.

Let us examine another example—the need for establishing satellite communication between two points where general purpose telephone lines are either absent or are in extremely unsatisfactory condition. (This example is typical of a Ukrainian province.) In like

fashion, communications can be established with, say, the Ukraine's peacekeeping subunits in the former Yugoslavia or Angola. In this case VSAT stations would have to be installed at both ends of the planned satellite communication channel. Spelt out in (applicable) protocols, the INFOCOM firm has the technical capacity for establishing communications between them directly via satellite.

But the main area for which VSAT ideology was developed is data transmission over satellite communications networks. Consequently, bringing together local computer networks located considerable distances apart is a domain in which neither conventional telephone networks nor fiber optic ones can compete. Satellite networks are significantly superior to all others in the quality of services proffered even in the USA where as we know, general-purpose telecommunications are in an excellent state.

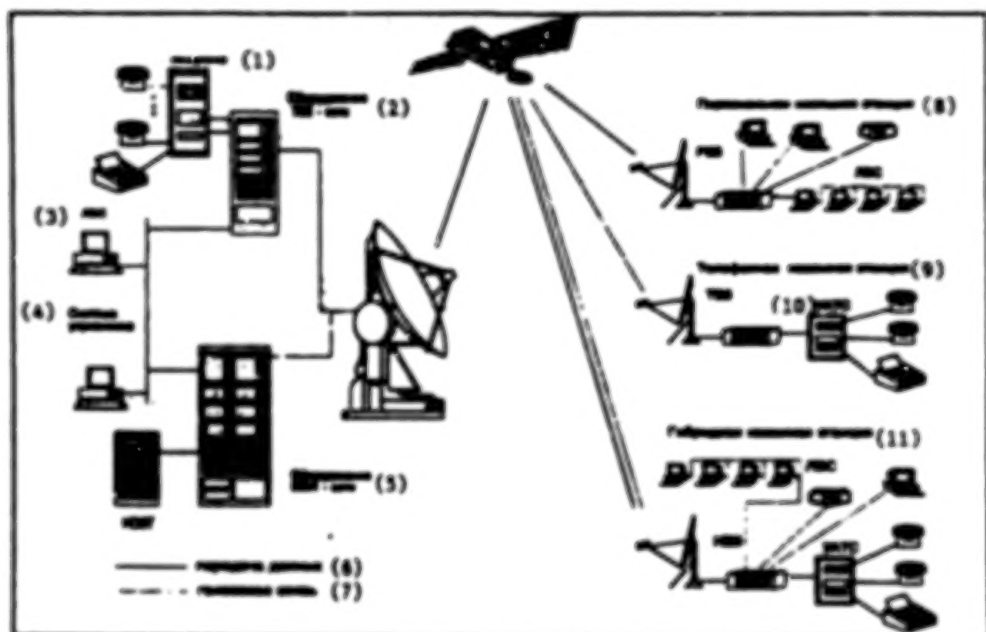
Depending upon the equipment used, the customer may be provided with a "transparent" channel for transmitting data at rates ranging from 2.4 kilobits per second to 8.4 megabits per second. A signal from one station to another traverses the path from the Earth to the satellite twice—that is, a distance of not less than 140,000 km, and therefore it is "delayed" for not less than 0.5 seconds. However, this discrepancy is not sensed by the network user. He should be much more concerned about the price for the communications traffic. In this case, the price is very favorable, even when the volume of information to be transmitted is insignificant. The usual price of transmitting 1 megabyte is on the order of \$20.

INFOCOM-SK is now building and installing its own satellite communication system control center—a hub station, which will make it possible to utilize the possibilities of satellite communication more effectively, especially in the case of a user whose network resources have a control center in Kiev.

Let us consider the technical possibilities of the system to be built. The satellite communications networks described above were characterized by a specialized functional orientation. They provide either for data transmission coupled with optional telephone services or telephone communication with additional possibilities for data transmission, in neither case simultaneously ensuring same-price service for one or the other form of communication. INFOCOM-SK, being a distributor for the American firm HNS, is equipping itself with a hybrid satellite communication system developed by HNS in 1994, being based upon the ground stations of HES, a provider of high-quality data transmission services

and telephony (see figure). The HES system consists of a satellite business communication network (ISBN), which provides multiple access by frequency and time multiplexing, and a satellite telephone communication network with on-demand channel allocation. The hybrid satellite communication network itself structurally

unites a satellite (Intelsat-515, with a transition to be made to Intelsat-702 in 1996), a central hub station, and HES user hybrid ground stations. The satellite's zone of operation covers Western and Eastern European territory as far as the western regions of Russia, as well as some parts of the Near East.



Satellite Communication System Based on HES Hybrid Stations

Key: —1. Switchboard —2. TES network equipment —3. Computer —4. Control system —5. ISBN network equipment —6. Data transmission —7. Voice communication —8. Ground-based PC workstation —9. Telephone ground station —10. Control automatic telephone exchange —11. Hybrid ground station

The central station for switching data among any of the HES network stations provides communication between users and carries out all of the tasks of controlling the ground-based satellite communications stations, including administration, reconfiguration, the setting of operating modes for code equipment, equipment for user stations, and diagnostics.

The capabilities of a hybrid satellite communication network have no equals in the terms of spectrum of communication services. The integrated satellite business communications network provides for transmission of data for network customers in a connecting configuration "one to all others," using more than 10 channel and network protocols, including X.25, TCP/IP, SNA etc. The ISBN uses outgoing channels with a throughput of 128 kilobits per second or 512 kilobits per second. The number of incoming channels connecting to each outgoing channel can be varied from 1 to 32 depending

on the anticipated loads and the response time needed. Joint access using frequency and time multiplexing of the channels and switching of the incoming channels make it possible to have several VSATs working in the network—thousands of terminals.

As far as the possibilities of TES or HES stations are concerned, they allow creation of territorially distributed institutional networks. In this case, within an HES network, a principle was employed whereby satellite communication channels are not rigidly assigned to a discrete user, but are instead provided to him on request. HES stations provide telephone communications as well as data transmission (using X.25 and PCP/IP protocols) among all users of the network.

We note in conclusion that there are now more than 100,000 users of VSAT networks in the world. Satellite communications services are in a particularly developed state in the USA. In Europe this process was artificially

constrained by high fees for installing and using satellite communications systems. However, after they were dramatically reduced, and gone away with altogether in some places, Europe underwent a veritable boom in satellite communications. From 1993 to 1994, the number of VSAT stations almost doubled here. Up to the time of this article's publication, in the Ukraine, only the limited joint-stock company, INFOCOM-SK, was in place and more than 30 satellite communications stations of various types were in operation. Delegations

from the United Nations, RANK XEROX, SITA, R. J. Reynolds Tobacco International, and the REUTERS Agency in Kiev have become customers of this firm. The Ukrainian Ministry of Defense is using the services of INFOCOM to access the Internet.

Institutions and enterprises interested in developing cooperation in the Ukraine and abroad are displaying increasingly greater interest in state-of-the-art satellite communication technologies.

Russia: Features of Structural-Phase State of Surface of Titanium Alloys Exposed to Powerful Ion Beam

964D0490A Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian Dec 95 No 12 pp 68-72

[Article by G.I. Gering, V.S. Kovvichak and T.K. Panova, Omsk State University (manuscript received 25 Jun 95); UDC 669.14.018.621.046.537.534.9]

[FBIS Summary] The objective of this study was a clarification of the role of various phenomena observed during the process of hardening of titanium alloys and a determination of the relative importance of each of them. This required a clarification of the nature of the phase and structural transformations in the titanium matrix. Structural changes in surface layers of (α + β)-titanium alloys under the influence of a powerful ion beam were studied, and the influence of the initial state of the alloys on the structural-phase changes transpiring in them are demonstrated. The types of alloys investigated were VT-6 with two types of initial structure (coarse-grained platy and globular) and VT-8 with a globular structure. The impact of a powerful ion beam on the surface of (α + β)-titanium alloys with these different initial structural types results in the formation of a spatial region with a characteristic morphology, phase composition and microhardness. The observed differences in structure of the transition zone for titanium alloys with a different initial structure are evidently related to the substantial difference in the energy expenditures required for transformation of a coarse-grained structure into a fine-grained structure. The impact of a powerful ion beam is characterized by wave deformation, manifested in the drawing out of the grains in the direction of wave propagation. The appearance of a pitted surface is evidently related to beam nonuniformity and influence of the forming vapor-plasma cloud. Figures 4; references: 7 Russian.

Russia: Full Profile Analysis of Diamondlike Films Described

964D0490B Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian Dec 95 No 12 pp 87-91

[Article by A.D. Bozhko, A.P. Kobzev, D.A. Korneyev, L.P. Chernenko, and D.M. Shirokov, Joint Nuclear Research Institute, Dubna (manuscript received 25 Jun 95); UDC 539.171.016]

[FBIS Summary] Carbon amorphous diamondlike films (CADLF) containing tungsten have unique mechanical, chemical and electric properties. The depth profiles of the concentration of all elements present in CADLF were obtained by joint processing of the spectra of Rutherford and resonance scattering of helium protons and ions, recoil protons and characteristic x-radiation.

Nondestructive nuclear physics methods were used in this research. The films used in the experiments were grown on dielectric substrates in a d-c diode reactor. The tungsten was introduced into the growing film by magnetron spraying. C-Si self-stabilizing amorphous structures create an ideal matrix for the introduction of various metals. A unified self-consistent CADLF model was constructed and a full profile analysis at a nanometer scale was made. Using this model and analysis studies were made of series of CADLF samples. The full cycle of analysis of samples included the following experiments: 1. Measurement of the Rutherford backscattering spectra of helium ions, 2. Measurement of the backscattering spectra of helium ions near the known resonance in the elastic scattering of helium ions on oxygen at an energy 3.045 MeV, 3. Measurement of the spectra of recoil protons during bombardment of the sample by helium ions, 4. Measurement of the backscattering spectra of protons near resonance in the elastic scattering of protons on carbon at an energy 1.73 MeV, 5. Measurement of the spectra of characteristic x-radiation excited by protons in CADLF. The results obtained in one of the samples of this series are given. The research demonstrates the broad possibilities of nondestructive nuclear physics methods in the solution of timely problems in solid state physics. Figures 5; references: 2 Western.

Ukraine: Structural Features of Weldable Titanium (α + β)-Alloys of Ti-Al-Mo-Nb-V-Zr System

964D0487 Kiev *AVTOMATICHESKAYA SVARKA* in Russian Jan 96 No 1, pp 3-9

[Article by V.N. Zamkov, doctor of technical sciences, and V.F. Topolskiy, candidate of technical sciences, Electric Welding Institute (Imeni Ye.O. Paton, Ukrainian National Academy of Sciences, Ye.Ye. Vlasenko, engineer, N.P. Kushnareva, candidate of physical and mathematical sciences, and M.N. Musiyenko, engineer, Metal Physics Institute, Ukrainian National Academy of Sciences (manuscript received 8 Jun 95); UDC 621.791.669.295.620.18.539.67]

[FBIS Summary] The titanium (α + β) alloy SP15 of the Ti-Al-Mo-Nb-V-Zr system in cast and formed states has higher plasticity characteristics than other titanium alloys. The alloy SP15 is recommended as a construction material, being characterized by a good combination of strength and plastic properties in a wide temperature range and excellent resistance to corrosion. Further improvement in the alloys of this system in the direction of an increase in the concentration of niobium and vanadium and a decrease in the content of aluminum, molybdenum and zirconium led to creation of the alloy SP15U, which also has good strength and plastic properties. A study was made of the positive influence of niobium and vanadium on the physicomaterial properties of these two alloys, as a point of departure using the well-known (α + β) alloy VT-6 (90 percent α -phase). Microstructural details are discussed. With an increase in

the content of niobium and a simultaneous decrease in the content of aluminum, molybdenum and zirconium in ($\alpha + \beta$) alloys in the Ti-Al-Mo-Nb-V-Zr system there is a considerable pulverization of the structure of the phase components, as well as a tendency to a change in the morphology of the phases from platy to acicular. The atoms (oxygen, nitrogen) introduced into the β -phase are redistributed during aging into the α -phase and to the interphase α/β -boundaries. The boundaries of the microstructural grains of the alloy SP15 are enriched with aluminum and vanadium; in the alloy SP15U the degree of their enrichment is reduced. Figures 5; references 10: 4 Russian, 6 Western.

Ukraine: Electron Microscope Study of Structure of Weldable Titanium ($\alpha + \beta$)-Alloys of Ti-Al-Mo-Nb-V-Zr System

964D0644A Kiev AVTOMATICHESKAYA SVARKA in Russian Feb 96 No 2, pp 11-14

[Article by P. Yu. Volosevich, candidate of physical and mathematical sciences, Ye. Ye. Vlasenko, engineer, N. P. Kushnareva, candidate of physical and mathematical sciences and M. N. Musiyenko, engineer, Metal Physics Institute, Ukrainian National Academy of Sciences, and V. N. Zanikov, doctor of technical sciences and I. K. Tyapko, engineer, Electric Welding Institute imeni Ye. O. Paton, Ukrainian National Academy of Sciences; (manuscript received 28 Jun 95, after revision 20 Oct 95) UDC 621.791.052:669.295:620.18:539.67]

[FBIS Summary] The background for this study was outlined in a recent article by V. N. Zamkov, et al. in this same journal, No 1, pp 3-9, 1996. The well-known VT-6 ($\alpha + \beta$)-alloy (90 percent α -phase) was selected for comparison of the nature of the structural change in the alloys with their alloying by niobium. An electron microscope study confirmed a more disperse (by a factor 5...10) structure of the decay products in the alloys SP15 and SP15U in comparison with the alloy VT-6, evidently attributable to the presence of niobium in the alloys. The research indicated that there are two types of decay in an alloy with a higher niobium concentration. With a laminated structure of the ($\alpha + \beta$)-phases mixture the decay occurs along the boundaries and spreads into the depths of the primary α -phase; with an increase in the volume of the β phase there is decay within the latter, transpiring in a definite crystallographic direction. A favorable combination of structural parameters is attained in a foil of the SP15U alloy: recrystallized fine grains of the α -phase (the size of which is evidently limited by the thickness of the foil) and decay products in the form of an ($\alpha + \beta$)-mixture with a high degree of dispersion. Figures 3; references 5; 3 Russian, 2 Western.

Ukraine: Influence of Jet-Abrasive Processing in Course of Plasma Spraying on Resistance of Nickel-Based Coatings to Erosion

964D0644B Kiev AVTOMATICHESKAYA SVARKA in Russian Feb 96 No 2, pp 20-23

[Article by S. L. Revo, candidate of physical and mathematical sciences, and N. N. Dashevskiy, scientific specialist, Kiev National University imeni Taras Shevchenko, and A. L. Borisova, doctor of technical sciences, Electric Welding Institute imeni Ye. O. Paton, Ukrainian National Academy of Sciences; (manuscript received 16 Mar 95, after revision 5 Apr 95) UDC (621.793.72-761:539.9):669.245620.193.1]

[FBIS Summary] A study was made of the possibility of enhancing the performance characteristics, especially resistance to erosion, of items with nickel-based plasma coatings by their exposure to a stream of abrasive particles during the application of the coatings. The structure of the plasma coatings produced under conditions of a jet-abrasive impact is characterized by improved properties. These include, in particular, a decrease in the porosity of the coatings by a factor of not less than two and also an increase in the degree of microcrystallinity and uniformity of the phase composition in the thickness of the coatings. In addition, both in samples with coatings produced by ordinary spraying and in samples obtained with jet-abrasive processing the effect of an improvement in their damping properties is retained, whereas the level of internal stresses in both cases virtually does not change. For special purposes jet processing with the participation of particles wetting the coating makes possible an additional increase in its density and ensures a given change in the properties of the surface layers (such as electrical and thermal conductivity, resistance to corrosion, etc.). All these factors in general favor an increase in the resistance of the samples with coatings to aeroabrasive erosion and can be used for increasing the useful life of gas-turbine aircraft engines. Figures 2; references: 11 Russian.

Russia: Ceramics Produced by Combustion

964D0596A Paris L'USINE NOUVELLE in French 15 Feb 96 p 66

[Article by Christian Guyard: "Ceramics Manufactured by Combustion"; introductory paragraph in boldface as published]

[FBIS Translated Text] Developed in Russia, this ceramics manufacturing process is simple and fast and does not require large facilities.

The process bears some resemblance to aluminothermy, in which a mixture of aluminum powder and iron oxide is burned to produce a solder. The fact remains, however, that the synthesis of ceramics by self-propagated

combustion, known as SHS (self-propagating high-temperature synthesis), is somewhat surprising.

You mix powders that have been carefully chosen for their composition and granulometry, compress them, and ignite one end. The high-temperature reaction then propagates itself at a speed of a few centimeters per second, leaving the desired material behind it. After that, one need only grind the ingot to obtain a powder. But one can also use the heat thus produced to carry out compaction and extrusion. Even better, one can take a compacted shape consisting of crude materials, subject it to the same reaction, and obtain a piece very close to the desired final dimensions.

The process is applicable to a very large variety of ceramics: pure or compound carbides, nitrides, borides, or silicides, intermetallic compounds, ferrites, YBaCuO superconductors, and so on.

"This is a technology of the 21st century," said Alexander Merzhanov, head of Isman—Russia's Institute of Structural Macrokinetics—during an information day on materials expertise that was sponsored in Grenoble recently by the Rhone-Alpes Agency. Since the first synthesis of titanium boride in 1967 and the discovery of that "solid-flame" phenomenon, Isman has synthesized over 500 different products.

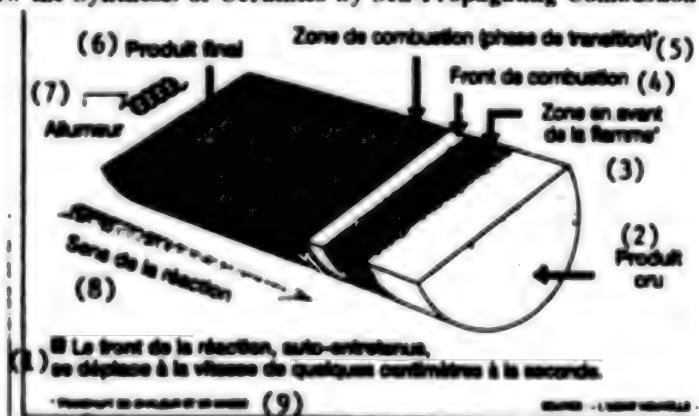
The process is a simple one: mixing powders, shaping them, reaction, and grinding or final shaping. The reaction produces its own heat, so there is no need for a kiln or for energy. But the right reagents must be selected with the help of thermodynamics, and mixtures with the proper granulometries and compositions must be chosen using kinetic studies.

The process can employ five methods of synthesis. There is the direct method using elements (carbon and titanium for titanium carbide, silicon and molybdenum for molybdenum silicide), compounds (lead oxides and tungsten oxides to obtain lead tungstate), or even compounds and elements (titanium, barium oxides, and titanium oxides for barium titanate). Then there is synthesis involving aluminothermy or magnesiothermy, and lastly, there are complex reactions for compounds of the YBaCuO type. Some compounds can be produced by a gas (nitrogen for nitrides, for example), by ores, or even by solid waste.

Alexander Merzhanov says he is open to all kinds of cooperation ranging from the supplying of powders to the granting of licenses and joint ventures. A GIE [economic interest group] is already operating in Spain, where it produces batches of about 100 kg each. SHS Spain Prometheus combines the TGI and the ENSB, two firms belonging to the INI/Teneo group (a subsidiary of the United Technologies Research Center in the United States) and Sime, Isman's Spanish subsidiary. It produces aluminum nitrides, silicon nitrides, and Sialons [as published], as well as chromium carbides and mixed carbides of titanium and chromium. It has also worked on automating the process.

Elsewhere in Europe, synthesis by combustion has not been the subject of much study. A Brite program is underway regarding the synthesis of electrode materials for aluminum electrolysis (a venture by the Heraeus group and two Italian companies, Aures and Enea). In France, the School of Industrial Ceramics in Limoges has just issued a thesis on the subject.

How the Synthesis of Ceramics by Self-Propagating Combustion Works



Key: —1. The self-sustained forward edge of the reaction travels at a speed of a few centimeters per second. —2. Raw product. —3. Area ahead of the flame. —4. Combustion front. —5. Combustion zone (transition phase). —6. Final product. —7. Igniter. —8. Path followed by the reaction. —9. Transfer of heat and mass.

Multiple Applications

The ceramics obtained by the SHS have many applications: hard compounds for surfacing operations or cutting tips, abrasives, anticorrosion and antiwear coatings, resistors for very high-temperature furnaces, ferrites for electronics, and materials of high purity for optoelectronic crystals, but also forms for metal rolling and wire drawing, fireclay crucibles, and even turbine buckets and impellers.

Ukraine: Electric Resistance of the Welded Joint Interface of a Carbon Material and a Metal Alloy
964D0685A Kiev AVTOMATICHESKAYA SVARKA
in Russian Mar 96 No 3, pp 28-33

[Article by V. I. Lakomskiy, Ye. O. Paton Institute of Arc Welding; (manuscript received 8 Sep 95, after revision 12 Dec 95) UDC 621.791.755.01:[621.315.56+669.715]]

[FBIS Summary] When carbon materials and metal alloys are welded together, physical and chemical interfaces are formed. The difference between the physical boundary and the chemical boundary is discussed, and ways of determining the location of the boundaries are

described. Boundaries can be extended if the metal has carbide-forming component or if the carbon material is porous. The extent of penetration of one material into the other is studied. The chemical boundary is found to be much wider than the physical boundary. The change in the electric resistance at the chemical boundary is studied beginning with an examination of the distribution of resistance in a pure metal in a cast state. Grain boundaries are found to always have a higher resistance than the bulk of the material. Admixtures have the greatest effect in increasing the resistance of the grain boundary; crystal lattice imperfections play a much smaller role. The resistance of a welded joint changes sharply at the physical boundary, but also changes due to nonuniform distribution of admixtures and phases within the chemical boundary. Equations are developed to describe the resistance at different areas of the welded joint. Arithmetic resistance values are obtained for plasma arc welded joints of a dense graphite material and an aluminum alloy. The width of the "reaction layer" is determined and the findings agree well with experimental results. Figures 7; table 1; references 10: 6 Russian, 4 Western.

Russia: New Standard Technology for Manual Ultrasonic Checking of Weld Seams in Equipment, Lines at Nuclear Power Plants (Review)

964D0153 Yekaterinburg DEFECTOSKOPIYA in Russian May 95 No 5, pp 62-78

[Article by V.Ye. Belyy, NPO Central Scientific Research Institute for Heavy Machine Building (manuscript received 9 Sep 94)]

[FBIS Summary] The special features of the new norm-setting technical document (NTD) on ultrasound checking of weld seams and beads for nuclear power plants "PNAE (Rules and Specifications for the Nuclear Power Industry) G-7-030-91" are examined in comparison with the earlier operative document NTD "OST 108.004.108-80." The methodological procedures for the checking of weld seams are validated in far greater detail than in previous materials. The new document constitutes part of the many-sided normative base for ensuring safe operation of equipment at nuclear power plants. For the first time the new document does not include quality assessment norms. However, the NTD does deal with assessment of the suitability of weld seams for ultrasound checking. For the first time a system has been introduced for the classification of weld seams by degree of suitability for checking (for the time being acoustic criteria are not taken into account). Three categories of accessibility for checking are introduced (each of these is defined). Also for the first time, devices have been recommended for measuring undulation and roughness of the outer and inner surfaces. The NTD has a special appendix with a description of the measurement method. A separate section is devoted to the organization of checking work. Information is given on the defectoscopes, transducers and samples used in this work. The checking is carried out by trained and certified defectoscopy specialists. An important difference between the new NTD and earlier standards is that for the first time for the range of weld seam thicknesses the checking parameters are not stipulated discretely, but for a range of frequency and angle values, an approach making it possible to choose optimum transducers and checking modes for ensuring reliability of defect detection. A pertinent table lists all types of weld seams. Another section deals with equipment, followed by specific procedures used in the search for and measurement of defects, ending with an approach used in assessing the admissibility of defects. Figures 6; references 30: 29 Russian, 1 Western.

Russia: Cascade Subcritical Enhanced Safety Reactor

964D0321A Moscow ATOMNAYA ENERGIYA in Russian Nov 95 Vol 79 No 5, pp 327-337

[Article by P.N. Alekseyev, V.V. Ignatyev, O.Ye. Kolyaskin, V.I. Mostovoy, L.I. Menshikov, V.N. Prusakov, N.N. Ponomarev-Stepnoy, and S.A. Subbotin, Kurchatov Institute Russian Science Center, and

Yu.G. Alenitskiy, A.K. Krasnykh, and L.N. Somov, Joint Institute for Nuclear Research; (manuscript received 31 May 95) UDC 621.039.522+621.384.6]

[FBIS Summary] The following objectives were pursued in this study: —1. choice of an optimum scheme for a safe subcritical reactor which would make it possible to achieve a high multiplication of neutrons without radioactive accidents and substantially reduce the intensity of the external neutron source, thereby avoiding the principal shortcomings of the traditional scheme with a proton beam: "gigantism" and costliness; —2. study of the possibility of use of accelerators as an external source of neutrons; and —3. assessment of the feasibility of introducing subcritical reactors into the structure of the nuclear power cycle. It was found that the problems of safety and efficacy of a future nuclear power plant and its fuel cycle in many cases can be solved by supplementing the system, in addition to thermal and fast reactors, by subcritical molten-salt reactors fed by an external source of neutrons which are generated using proton or electron accelerators. A special study was made of a cascade molten-salt reactor consisting of two cores: inner for fast neutrons and outer for thermal neutrons with a suppressed feedback between them. Such a scheme makes possible a sharp decrease in the power of the external neutron source. The most promising neutron sources are those based on linear resonance electron accelerators or sectoral proton cyclotrons. The fundamental possibility of producing nuclear power on the basis of solely one type of reactor, the subcritical liquid-salt reactor, is indicated. This would result in a simplification and lessening of cost of the entire nuclear fuel cycle. Figures 2; references 31: 15 Russian, 16 Western.

Russia: Improvement in Fuel Utilization, Operating Modes of Paksh Nuclear Power Plant Researched

964D0321B Moscow ATOMNAYA ENERGIYA in Russian Nov 95 Vol 79 No 5, pp 337-343

[Article by K.V. Simonov, Kurchatov Institute Russian Science Center, and I. Nemes, Paksh Nuclear Power Plant; (manuscript received 15 Sep 95) UDC 621.039.58]

[FBIS Summary] The results of scientific and engineering development work for the improvement of fuel utilization and the operating modes of the Paksh Nuclear Power Plant (NPP), carried out jointly by specialists of the Kurchatov Institute Russian Science Center and the Paksh NPP, are concisely presented. About 50 percent of all the electric power in Hungary is produced at this plant. The increase in the intensity of depletion of the fuel used at the nuclear power plant is validated, and the neutron physics characteristics of a 4-year fuel cycle with increased depletion are given. The conditions governing the organization of this fuel cycle are outlined, and all the pertinent cycle parameters are listed.

An expert evaluation was carried out and a new (for the VVER-440) approach to monitoring the distribution of energy release in the core, involving a direct restriction on the power of the most loaded fuel element, was used for the first power unit. Testing of methods for retrieving the energy distribution, serving as a basis for the principle of "hot spot" checking of the energy distribution, was carried out. Calculation of fuel element strength and temperature fields of the body of the reactor and steam generator indicated that it was feasible that they be operated in a power maneuvering mode. A strategy was therefore developed for control of core reactivity in such a maneuvering mode. The fuel elements used have the necessary safety factor for ensuring their use in three fuel cycles. The results of computational-experimental studies of the performance of fuel elements for the second generating unit when maneuvering reactor power are presented. These results are consistent with the work experience of the Novovoronezh and Kola NPP. References: 12 Russian.

**Russia: Research on Vibration Diagnosis
Characteristics of VVER-1000 Under Operating
Conditions**

964D0321C Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 343-349

[Article by V.V. Bulavin and V.I. Pavelko, Kurchatov Institute Russian Science Center; and D.F. Gutsev, All-Russian Nuclear Power Plant Scientific Research Institute; (manuscript received 20 Jun 95) UDC 621.039.56]

[FBIS Summary] Modern requirements for monitoring the condition of reactor equipment in the course of its operation are met by on-line diagnosis systems, especially a vibrational diagnosis system. Its effective operation is possible only after interpretation of the auto- and cross-spectral characteristics of the registered signals. A noise experiment was carried out for this purpose at the first generating unit of the Kalinin Nuclear Power Plant [NPP]. Three types of sensors were used. About forty 20-channel records obtained using these sensors made it possible to study a range of effects, each of which is examined in detail. These include the reactivity and local effects caused by vibrations of the reactor body and devices within the reactor body and especially vibrations in fuel element assemblies of different longevity, distribution of the amplitude of different acoustic standing waves within the body of the reactor and transfer functions with parameters which cannot be measured directly which characterize the thermohydraulic state of the core. The amplitude, phase, harmonic, and multivariate autoregression parameters of vibrations of units

within the body of the VVER-1000 were examined using the auto-, reciprocal and multivariate spectral characteristics of the noise registered by these three types of sensors. Several other effects were experimentally observed whose description had not previously appeared in the literature. Figures 12; references 3: 1 Russian, 2 Western.

**Russia: Checking Tightness of Nuclear Power Plant
Steam Generators With VVER-1000 After
Reconstructing Water Supply, Scavenging Systems**
964D0321D Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 350-353

[Article by Ye.A. Ivanov, I.V. Pyrkov and L.P. Khamyanov, All-Russian Nuclear Power Plant Scientific Research Institute; (manuscript received 17 Mar 95) UDC 621.181.021]

[FBIS Summary] An analysis was made of the radiative-technologic state of steam generators after reconstruction of the water supply and scavenging systems, the characteristics of distribution of radionuclides in the circulating water and also the representativeness of the systems for sampling the scavenged water. The reconstruction of the water supply and scavenging systems, carried out for the purpose of ensuring reliability of the collectors by means of intensification of the elimination of salt pollutants with the scavenged water, resulted in a considerable change in the hydrodynamic regime and a redistribution of impurities, including radioactive, in the boiler water volume. For steam generators with such reconstructed systems it is therefore incorrect to employ the method for computing leaks based on a single-chamber model of ideal mixing as set forth in the current instructions. A qualitative analysis of the physicochemical processes transpiring in the system gives evidence of the need for a radical reexamination of the model of migration and distribution of radionuclides in a water volume with allowance for hydrodynamic and thermophysical inhomogeneities, as well as uncertainty in the localization of tubular leakiness within the steam generator. These considerations may require a reexamination of the model described earlier by Ye.A. Ivanov, et al. in ATOMNAYA ENERGIYA, Vol. 77, No. 1, 1994. There are still other points in the current instructions requiring reexamination. The need to develop a correct method for diagnosis of small leaks in steam generators with reconstructed water supply and scavenging systems, as well as choice of safe operation criteria, is stressed. Figures 2; references: 5 Russian.

Russia: Method for Post-Radiation Determination of Fuel Irradiation Temperature

964D0321E Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 353-360

[Article by G.V. Momot, V.F. Solenkov and A.A. Khrulev, Kurchatov Institute Russian Science Center; (manuscript received 10 Aug 95) UDC 621.039.548]

[FBIS Summary] The most common method for determining the working temperature of the fuel in a fuel element is its measurement by thermocouples, but this method has considerable shortcomings and the temperature field may be distorted by introduction of the thermocouples into the fuel elements. The response of the thermocouples also changes as a function of the degree of irradiation in the reactor and interaction with the ambient medium. This is true even of relatively stable W-Re thermocouples which have a limited lifetime even at a relatively low temperature. A method was therefore developed at the Kurchatov Institute for determining fuel temperature during irradiation which is based on measurement of the leakage of radioactive gases (krypton, xenon) during the heating of preirradiated fuel samples. In the same way it is possible to find the temperature of construction materials which during irradiation are in contact with the fuel and which contain fission products which are introduced into the material from the surface layer of the fuel due to the kinetic energy of the fission products (for example, the jackets of thermoemission fuel elements). The results of determination of the irradiation temperature of samples of fuel of different types undergoing reactor tests are given. It was found that in a wide temperature range the measurement error does not exceed 5 percent. The method is not encumbered by serious restrictions on its use with respect to the irradiation integral or the range of measured temperatures. The possibility of determining the working temperature is dependent for the most part on the sensitivity of the radiometric instrument used. Figures 5; references 4: 2 Russian, 2 Western.

Russia: Calculating pH of Water Coolant in VVER First Loop

964D0321F Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 360-366

[Article by A.V. Gordeyev and B.G. Yershov, Physical Chemistry Institute, Russian Academy of Sciences; (manuscript received 29 Jun 95) UDC 621.039.534(204).012.05:092.19.001.24]

[FBIS Summary] On the basis of the dependence of the thermodynamic dissociation constants of KOH, H_2BO_3 , NH_3 , and H_2O on temperature, a kinetic scheme is proposed for calculating the pH of the heat transfer agent in

the temperature range from 0 to 350°C. The dissociation of boric acid is represented in the form of two equilibria. The reactions scheme also includes reactions describing the dissociation of such substances as KCl and HCl used in finding the boric acid dissociation constants. Figure 1 gives the dependence of the constants of acidic-basic equilibria for the considered substances. These results were then used for modeling pH changes in aqueous solutions to which boric acid and potassium hydroxide had been added. Using the equilibria represented in the table, the pH of the heat transfer agent was computed at the temperature of the first loop at a nuclear power plant with a VVER-440 and a VVER-1000. The H_2BO_3 and KOH concentrations in the computations varied from 0 to 12 g/liter for the first and from 0 to 62 mg/kg for the second. Figure 2 gives the results of such computations for 270°C. Although such dependencies give a graphic idea concerning the nature of pH change, a topographic representation of the data (Figure 3) may be more useful. These graphs show the change in KOH and H_2BO_3 content with retention of a constant pH. The dependencies presented here are consistent with those published by other authors. Figures 3; references 23: 5 Russian, 18 Western.

Russia: Use of Gamma Sight for Inspecting Reactors

964D0321G Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 367-370

[Article by A.G. Volkovich, O.P. Ivanov, V.Ye. Stepanov, A.N. Sudarkin, and L.I. Urutskoyev, NPT Rekom Kurchatov Institute Russian Science Center; (manuscript received 1 Aug 95) UDC 621.039.555+535.23.08]

[FBIS Summary] A new automated system for the remote visualization of radioactive objects — a gamma sight — is described. The first variant of the sight was used at the Chernobyl Nuclear Power Plant (NPP) in the summer of 1986. The upgraded instrument is an automated measuring system designed to obtain images of emitting objects. An annotated photograph shows its external appearance, and a detailed diagram shows the measuring head used in obtaining a gamma image of the object. The total angle of view is 20°, and the angular resolution is 1°. The detector used is a flat CsI(Tl) scintillation crystal 40 mm in diameter and 3 mm thick. An image converter amplifies the light image of the object and conveys it to a photodetector. A special converter with image reduction by a factor of 5 makes it possible to match the geometric dimensions of the scintillator and the photodetector. The photodetector is a low-noise charge-coupled device matrix with a photosensitive area measuring 8 x 8 mm, and the

number of image elements is 512×512 . The exposure time for one frame can be varied from 1 to 60 seconds. A lead shielding 25 mm thick reduces the number of gamma quanta incident on the detector. The operator is separated by a distance up to 200 m from the measuring point, which is connected to a computer by an axial cable. Examples are given of the use of the gamma sight for investigating contaminated reactor equipment (in a line, inside a heat exchanger, on room floor). It is shown that the use of such an instrument makes it possible to obtain more detailed information concerning the distribution of radioactive sources and considerably reduces the dose load on personnel. It can be employed when planning a program for deactivating contaminated workrooms or when disassembling reactors taken out of operation. Elimination of the most radioactive objects makes it possible to reduce the intensity of the exposure dose by several times. The instrument is superior to foreign equivalents, and in the future instrument response can be increased by a factor of 10. Figures 3; references 6: 2 Russian, 4 Western.

Russia: Angular Distribution of Bremsstrahlung γ -Radiation in Case of Thick Radiator

964D0321H Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 370-376

[Article by G.N. Potetyunko, Physics Scientific Research Institute, Rostov State University; (manuscript received 16 Dec 94) UDC 539.12.04]

[FBIS Summary] Beams of bremsstrahlung γ -radiation are studied with respect to their angular distribution in the case of a thick radiator. The analytic expression for such a distribution is a multiple integral of a complex function which contains large gradients, making its computation difficult. The highly accurate numerical algorithms require excessive computer time. As an alternative, computation-analytic methods are proposed (strictly analytic methods are out of the question) because such methods often provide an acceptable accuracy with small expenditures of computer time. It was found that such an approach is admissible for high-energy γ -quanta. Specifically, a study was made of the problem of computing the angular distribution of bremsstrahlung γ -radiation in the case of a thick radiator when the electron energy is greater than 5 MeV. The energy of the electrons in this radiator is considered an unambiguous function of the depth of their penetration. The angular dependence of the emission section of a bremsstrahlung γ -quantum is represented in the form of the product of a Gaussian and a correction polynomial. This gives a method not tied in to the specific form of the indicated section. The angular distribution of electrons in the radiator is thus described by a Gaussian

which is the first term of a Moliere distribution. The integral for the angular variable in the expression for the desired distribution is taken in analytic form, which in the integrand eliminates large gradients and reduces the problem to a single integral of a quite smooth function. A method is given for taking the angular and energy blurring of the electron beam into account. References 12: 9 Russian, 3 Western.

Russia: Physical-Mathematical Model of Volume Condensation, Transport of Aerosols in VVER Containment Shell

964D0321I Moscow ATOMNAYA ENERGIYA
in Russian Nov 95 Vol 79 No 5, pp 376-381

[Article by A.G. Godizov and A.D. Yefanov, FEI Russian Federation State Science Center; (manuscript received 14 Jul 94) UDC 536.24]

[FBIS Summary] A detailed study was made of heat and mass exchange processes in the sealed VVER containment shell when a leak appears in a high-pressure loop. A realistic scenario of such an event is analyzed. During such an accident there is a modification of the size distribution of the radioactive aerosol due to its encasement in water, diffusion into droplets and washing-out by droplets precipitating in the gravity field. The spectrum of the aerosol remaining in the volume after fog dissipation differs from the initial spectrum. The problems of the transport of radionuclides in the containment shell and the condensation of vapor in the space beneath the closed shell are closely interrelated. Equally closely related is the problem of transport and burning of hydrogen, because the presence of vapor and droplets exerts a considerable influence on the processes of formation of an explosive mixture. In the last analysis it is precisely this full problem which is the purpose of study of evolution of the vapor, droplet and hydrogen-air mixture forming as a result of rupturing of a high-pressure loop. The article therefore gives a physical-mathematical model of the pertinent microphysical processes: volumetric condensation and transport of radioactive aerosol in the VVER containment shell. It describes the evolution of the medium in the case of an accident with loss of the heat transfer agent. The equations for the mean values are derived in a diffusion approximation by direct calculation of the turbulent flows. A system of equations also is derived which can be used under a wide range of physical conditions for which the requirements of the diffusion approximation of the equations for a turbulent medium are satisfied. The system makes it possible to describe all stages in evolution of the fog in the containment shell (generation, full development and decay) and takes into account the various

physical properties of an aerosol exerting an influence on vapor condensation. References: 9 Russian.

Russia: Calculation of Migration of Radionuclides From Burial Sites

964D0321J Moscow ATOMNAYA ENERGIYA
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[Article by B.Ye. Serebryakov, Biophysics Institute Russian Federation State Science Center; (manuscript received 1 Sep 95) UDC 621.039.75]

[FBIS Summary] The migration of radionuclides from near-surface buried radioactive wastes was computed at the Biophysics Institute Russian Federation State Science Center under the 4-year (1991-1995) scientific coordination program of the International Atomic Energy Agency "Assessment of the Safety of Near-Surface Buried Radioactive Wastes." The task involved computation of the escape of radionuclides from the point of burial of radioactive wastes, including 20 burials of the same type in ground trenches or 20 concrete sepulchers 100 meters long. The assignment included selection of the six isotopes capable of creating the maximum dose loads on the population. Particular attention was given to ^3H , ^{14}C , ^{60}Ni , ^{90}Sr , ^{137}I and ^{230}Pu . Calculations were made using the numerical models of water filtration and underground migration of radionuclides developed at the institute. These models are described as applicable to the aeration zone, and the results of calculations of the inflow of radionuclides to the aquifer from a concrete sepulchre and a simple ground trench are given. Two-dimensional solutions are found in the plane perpendicular to the trench or concrete sepulcher. The developed models are now being used for assessing the safety of buried radioactive wastes, as well as in solving other problems related to the migration of radionuclides with groundwater (for example, underground migration of nuclides from the damaged unit of the Chernobyl Nuclear Power Plant and the cooling pond at that plant). Figures 4; references 6; 2 Russian, 4 Western.

Russia: General Approach to Reckoning of Mean Fields of Atmospheric Impurity Concentration

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[Article by V.A. Pitkevich, V.K. Ivanov, Ye.A. Ivanov, and T.V. Ramzina, All-Russian Nuclear Power Plant Scientific Research Institute; (manuscript received 12 May 95) UDC 543.257.1]

[FBIS Summary] A critical analysis is given of different methods for averaging the random fields of a surface concentration of an impurity in the atmosphere during an arbitrary time period. A universal approach is

proposed for the solution of this problem on the basis of retrieval, using experimental data, of the distribution function of states of the source-atmosphere system by application of automatic classification algorithms. The proposed method makes it possible to solve the problem of automatic classification of objects on a computer without any restriction on the number of classes or any special requirements on the representativeness of the set of objects fed to the input of the recognition device. In some cases, when the sample volume is small (about 100), it is possible to carry out automatic classification under conditions of complete a priori uncertainty directly on the basis of an analysis of the matrix of closeness of objects without employing unwieldy local optimization algorithms. Formula (six), together with expression (nine), whose derivations are given here, make possible efficient computation of the mean field of impurity concentration during any time period. The new averaging method has been used to compute the mean daily and mean weekly concentrations of radioactive noble gases in the monitored zone of the Chernobyl Nuclear Power Plant. A comparison of the results of computations made using this scheme and the measurement results will make it possible to draw conclusions concerning the reliability and applicability of this approach. References 16; 15 Russian, 1 Western.

Russia: Statistical Characteristics of Radiation Loads on Personnel Engaged in Chernobyl Cleanup Determined From Dosimetric Register

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[Article by V.A. Pitkevich, V.K. Ivanov, A.F. Tsyt, M.A. Makayutov, V.A. Maryash, and N.V. Shchukina, Medical Register Science Center, Russian Academy of Medical Sciences; (manuscript received 15 May 95) UDC 614.876(477):519.24]

[FBIS Summary] A detailed description of the files of dosimetric data entered into the Russian State Medical-Dosimetric Register (RSMDR) for participants engaged in cleaning up the consequences of the Chernobyl Nuclear Power Plant (NPP) accident is given. Data now incorporated in the RSMDR on the irradiation dose for 119,416 individuals involved in the accident cleanup (75.1 percent of the total number of registered persons) were used in arriving at different statistical characteristics making it possible to evaluate the degree of reliability of the collected information. The distribution of the absorbed dose is given as a function of the date of onset of the work undertaken, the distance from the point of residence or work to the Chernobyl NPP and the length of time spent in the zone. An analysis for different groups of participants engaged in liquidation of the

accident consequences indicated that the RSMDR dosimetric data as a statistical ensemble are consistent with the radiation conditions in the Chernobyl NPP accident cleanup zone. This massive amount of data has been analyzed and is reflected in a series of figures and tables: Table 1 — Contamination of 30-km zone of Chernobyl NPP by some long-lived radionuclides; Table 2 — Fallout density of some radionuclides in 30-km zone; Table 3 — Mean dose loads on participants engaged in liquidation of accident aftereffects (1986-1990); Table 4 — Mean dose loads on participants as function of distance to Chernobyl NPP; Table 5 — Characteristics of different dose groups 1986; Table 6 — Mean characteristics of dose loads on participants in 1986 for some populated places and times when work was conducted in zone of radioactive contamination; Table 7 — Mean dose loads on participants determined from departmental subregisters. References 16: 15 Russian, 1 Western.

'Russian Wind Generator Developments'
(1992-1995)

964D0516A Moscow ENERGIYA: EKONOMIKA, TEKHNIKA, EKOLOGIYA in Russian Nov 95
No 11, pp 20-26

[Article by Ya.G. Sobol, candidate of technical sciences]

[FBIS Translated Text]

Technology as Old as the World

Harnessing the wind is one of the oldest methods of producing energy. The first evidence of wind engines dates back centuries ago; such equipment was used in China and in Japan about 2000 years B.C. In ancient Babylon during Hammurabi's reign wind engines were used for swamp drying. Persian wind mills in the seventh century B.C. had vertical-shaft turbines and equipment very much resembling wind flow concentrators with control panels (V.A. Korobkov, *Preobrazovaniye Energii Okeana* [Conversion of Ocean Thermal Energy], Leningrad 1986). Wind engines appeared in Egypt in about the first century B.C. and not before twelve centuries later in European countries (the first mention about wind mills is found in French annals dated 1105 A.D.). Until the 19th century wind and water turbines were the only rotating sources of mechanical energy. They were later quickly displaced by steam engines and only in the second half of the 20th century, when construction of powerful wind plants became feasible, did they attract a strong renewed interest. The "oil crisis" did a lot to contribute to this trend. Quite understandably: in comparison with alternative energy sources, wind energy is the most promising one from the standpoint of available reserves, accessibility, and multipurpose usefulness. De-

spite of this, however, adoption of wind-electric power into practical energetics is proceeding at a slow pace. There are several reasons for it.

The first reason relates to the peculiarities of wind as an energy source, namely its extreme variability. This complicates the design of wind-electric sets, degrades their performance, and makes availability of other electric generators as standby a necessity. Worldwide experience has demonstrated that wind-electric plants are less cost effective than Diesel-electric ones in regions where the mean-annual wind velocity is below 4.5-5.0 m/s and fuel delivery is not very expensive.

The power developed by a wind wheel is proportional to the wheel diameter squared, i.e., to the cross-sectional area of the oncoming air stream, to the wind velocity cubed, and to the wind energy utilization factor. This factor is determined principally by the aerodynamic characteristics of the wind wheel and varies from 0.48 to 0.51 for the most modern wind engines. Most existing wind-electric plants can, therefore, begin to deliver useful power only when the wind velocity is at least 4-5 m/s and operate at full rated power level only at a wind velocity of 8-10 m/s. When the wind velocity becomes 25 m/s, however, it becomes necessary to shut down the plant and thus avoid subjecting both the wheel and the tower to heavy overloads.

The second reason for slow development of wind-electric plants is their high per-unit capital requirement. The unit cost of installed wind-electric power fluctuates over the 1000-2000 \$/kW range and thus is several times higher than the per-unit capital investment in low-power up to 300 kW Diesel-electric plants.

'Vetroen' Yesterday and Today

For over thirty years now the NPO [Scientific-Industrial Association] "Vetroen" has been developing, preparing, and introducing a wind technology. Until recently its production program covered a wide range of low-power (0.12-16 kW) wind-electric and water-lifting plants suitable for the entire USSR territory including its most remote regions.

During the 1994-95 period "Vetroen", upon request from the RF [Russian Federation] Ministry of Agriculture, began working on a project to install wind power supplies on 20 farms in the Kraenoyarsk Oblast. On these farms are now accordingly being installed individual power systems consisting each of an AVEU 6-4M wind-electric generator set, a 3-4 kW Diesel-electric generator, a storage battery, and a d.c.-a.c. inverter. Such a system provides uninterrupted power delivery. The storage battery can supply adequate power at least 7 hours long and, therefore, it is not necessary to activate the Diesel engine as the power source for lamps, television sets, refrigerators, and washing machines during short periods of low wind velocity or calm air.



AVE-250 Wind-Electric Generator Set

Upon request from the Komi Regional Power System Administration, 30 km west of Borkuty in the foothills of the Arctic Urals is also being built a wind-electric plant "Zapolyarnaya [Arctic]" based on an AVE-250S wind-electric generator set.

This is the first practical experience worldwide in construction and operation of a wind-electric plant beyond the Arctic Circle. The main purpose of the "Zapolyarnaya" wind-electric plant is to supply power to the pumps along the Usinsk aqueduct and thus prevent an interruption of water delivery to the city in case of a fault along the electric transmission line caused by a strong cold wind, such winds developing in this region a velocity head which can reach 48 kg/m^2 . Interruption of water flow along the aqueduct at a temperature which here sometimes drop to -52°C does, moreover, cause the water to freeze within 6-8 hours. The rest of the time this wind-electric plant is to feed into the district power network.

In order to make such a mode of operation feasible, it is necessary to install additional equipment which will ensure compatible operation of several wind-electric plants feeding into the district power network. The most acceptable solution to this problem has been found to be two successive electric-current conversions ("insertion of a d.c. intermediate stage").

The installed power in a plant consisting of ten 250 kW wind-electric units is 2.5 MW. The operating voltage is 6 kV. The site of the "Zapolyarnaya" plant is on the right bank of the Usa River, where it covers a $500 \times 700 \text{ m}^2$ large area so that there is room for addition of 20-30 more such wind-electric units whenever necessary. The control post is located in the center. The plant operation will be controlled from the dispatch station which controls the electric power networks in Borkuty and to which the necessary information will be transmitted over a radio channel.

Installation of the sixth wind-electric unit is now completed. The first four units are connected to the power network and are operating in the pilot-commercial service mode. Preliminary work is being done for installation of two more sets. They already began designing the station facilities. When finally put in service, the station will operate with a minimum of regular personnel. The rated output of the "Zapolyarnaya" wind-electric power plant should be about 3500 MW.h annually. Completion of its construction and beginning of its operation are scheduled to take place in 1996. In the meantime, the station personnel are jointly with NPO "Vetroen" representatives finalizing the plant operation, maintenance, and technical support procedures under various conditions. They are also checking out new technical decisions, the electrical power circuits, and the control system.

In two years of construction activity the "Vetroen" specialists have acquired unique experience in installation and operation of wind-electric plants under Arctic conditions. This made it possible to proceed to the next stage: modernizing the basic AVE-250 wind-electric generator set. The main goal is to raise its nominal power rating to 300 kW and to improve its reliability by using a new electric generator, one which has a higher power rating at 600 rpm and thus a lower speed. At a lower speed, moreover, there is a much lower probability that resonance vibrations develop in the electromechanical system.

Focus on Prospects

The project most promising for the next decade undertaken by the NPO "Vetroen" is the GYURZA. In accordance with the project goals, a new class of highly efficient and highly economical plants is to be constructed to serve as basic power sources for most diverse objects in the national economy. The power ratings of these plants should cover the 0.1-300 kW range (Table 1).

Table 1. Gyrza Series of Wind Generators

Type	Power Range in Kilowatts	Type of Exploitation
Gyrza-M01	0.1 - 0.25	Autonomous, transportable
Gyrza-M1	0.5 - 1.0	Autonomous, transportable
Gyrza-10	4.0 - 16.0	Autonomous/local network, movable
Gyrza-50	32 - 50	Local/industrial networks, stationary
Gyrza-250	100 - 300	Local/industrial networks, stationary

Table 2. Comparison of Operating Characteristics of Wind-Electric Plants

Indicators of wind utilization	Known in the world	GYURZA-type wind-electric plants
Plants begin to deliver power at wind velocity, m/s	3-5	1.0-2.5
Reach full rated output level at wind velocity, m/s	8.5-12	1.5-6(7)
Annual duty time factor K on annual basis	0.2-0.3	0.55-0.75
Wind energy utilization factor		0.4-0.58

This new generation of wind-electric plants must be capable of producing electric energy wherever the mean-annual wind velocity does not exceed 4 m/s (regions of such low wind velocities constituting 80 percent of Russia's territory).

This exceptionally difficult scientific-technical problem could be solved only on the basis of a new approach to wind wheel aerodynamics: use of new devices and methods for organizing the aerodynamic flow converger stage so as to maximize the wheel area which the air flux will concentrate and thus maximize the extracted wind power.

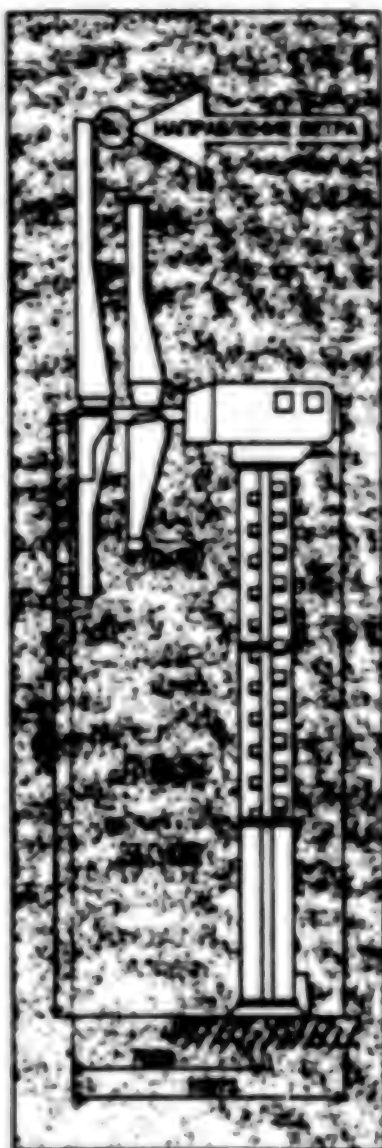
Already in the installation planning stage there are provisions made for doing it without the use of cranes and for facilitating the repair of machines with the highest power rating. Construction work is done using the most advanced engineering methods and materials well proven in military technology, in spacecraft technology, and in aircraft manufacture. The GYURZA plants are designed in accordance with European safety criteria.

The service life of GYURZA plants is 25 years, 15 years till the first major overhaul after 120,000 hours of generating power. Let us mention here, for comparison, that the existing wind-electric plants generate power for only up to 45,000 hours during their 20 years long

service life. It is assumed that the new plants, when operating in Russia's climatic zones other than the chernozem belt, will have recovered their cost in four years.

According to our calculations, wind-electric plants of this new generation should cost \$1000-1600 per kilowatt of installed power. These figures correlate closely with those in other countries, where the cost of the first wind-electric plants ranged from \$1,500 to \$3,000 per kilowatt of installed power. Their cost dropped to 1000-2000 \$/kW as the scale of their operation expanded, although the cost of very large and very small such plants still remains within the 3000-4000 \$/kW range. Considering that the power utilization factor is at least twice as large now (0.55-0.75 as compared with 0.24-0.27) and a correspondingly higher energy output, these wind-electric plants may in the future seriously compete with Western technology.

The GYURZA design is innovative on the global scale and utilizes several technologies in the "know-how" category. The complete engineering documentation for constructing a 150 kW wind-electric generator set is already available. This will be the first prototype machine of the new generation. The manufacturers have already been selected, wheel and tower blueprints are ready, and preparation for production are underway.



This is how high-power (150 kW) GYuRZA-series wind-electric generator set will look

Key: —a. wind direction

The first two units are scheduled to be available for demonstration in 1996, from the end of its first quarter to the beginning of its second quarter. This first model is to be followed, in 4-6 months intervals, by prototype units of a 30 kW wind-electric generator set.

From User's Standpoint

It is well known that the residential and communal sector of a village consumes up to one half the total energy

in all its forms. More than two thirds of the energy is expended on heat supply and powering domestic appliances. The current tendency to enlarge garden plots around living quarters, to expand farming households, to build-on second floors for more comfortable living, and to form new settlements for either refugees or military service personnel keeps raising the demand for energy even higher.

Besides, while on the one hand meeting agricultural needs is an "inconvenient" task for centralized electric power networks, these needs are on the other hand technologically tied to the overall energy production and consumption balance and thus very much dependent on reliability. For instance: an only two hours long electric power outage during milking will cause a loss of milk production not only on that same day but on the following 10-12 days. One milking of 240 cows requires 12-30 kW.h of energy and the loss of milk production in such an event will reach 36,000-40,000 liters. The problems of compensating the milk producing farmers for such losses do not only still remain practically unsolved but are yet to be properly worked on.

This means that it is farmers who are most concerned about reliability and quality of electric power supply. They face the task of producing on their own at least a part of the energy they need. Which kinds of power generating plants are preferable?

In order to supply of electric energy to an individual user who requires 3.5-5 MW.h annually, it suffices to install a 4-16 kW GYuRZA wind-electric plant or commercially produced 4 kW AVEU 6-4M units.

For more developed farming households is more expedient a local network consisting of several 32-50 kW GYuRZA units.

It is the author's opinion that best suited for rural settlements are wind plants with 32-50 kW wind-electric generator sets. The number of such sets in a plant will depend on the user's capability and on the wind pattern in the given locality.

Meeting the energy requirements of large villages and their households will already require wind-electric plants with generator sets of 100 kW or larger size. Such wind plants will also be suitable for settlements of the town size, including those hooked into one common electric power network.

In Lieu of Conclusion

Although the country's basal energy needs and demand for energy carriers are now met and about 20 percent of

the total energy production (1.4 billion tons of equivalent standard fuel) provides up to 70 percent of the revenue from exports, the fuel-and-energy system in the Federal Republic is still in a deep crisis. Practically the entire "strength reserve" has been exhausted due to depletion of the basic means created by the effort of previous generations. In fact, fuel and raw material resources indispensable for our children and grandchildren are being sold away. The outlook in this direction is a precipitous breakdown of the power apparatus accompanied with an attendant avalanche-like worsening of the energy and ecological crisis in the absence of countermeasures.

Furthermore, the rise of fuel prices along with the increasing acuteness of ecological problems on the one hand and the significant achievements made in power apparatus development and in construction engineering on the other will undoubtedly very soon increase the profitability of small plants running on renewable energy sources for local power consumers. Increasing the contribution of such plants to the overall power generating system and especially their contribution in regions far removed from power system trunk lines is becoming a realistic way to improve the reliability of energy supply to the country's population and industry.

Table 3. Comparison of Rated Electric Energy Production by GYuRZA-100, GYuRZA-250, and AVE-250 Wind-Electric Plants

			Electric energy produced, MWh annually		
Site of proposed plant		Average wind velocity, m/s	GRZ-100	GRZ-250	AVE-250
Dvinskaya	Yeney	3.1	384	584	198
	Uchani	3.1	284	250	
Yakutskaya	Tikich	5.1	468	753	314
	Kyuyur	4.1	416	649	261
Kamchatka	Chernovost	6.8	572	990	532
	Izba	5.1	486	658	350
	Lopuka	9.6	626	1136	759
Magadan Oblast	Arkapala	2.5	230	326	84
	Botuychug	7.8	588	1050	591
Iskhalin	Kuvakov	4.8	486	798	350

Russia: Xenon Gas Buffer Improves Laser Performance

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[Article by V. V. Kubarev, Institute of Nuclear Physics (mem) G. I. Budker, Siberian Department, Russian Academy of Sciences]

[FBIS Translated Text] It is established experimentally that xenon is an effective buffer gas for HCN, DCN and H₂O high-frequency pumped lasers. The greatest effect—a fivefold increase in output power and efficiency—was observed at the line for which $\lambda = 189.95 \mu\text{m}$ with a DCN laser. Xenon increases these parameters by 33 percent in HCN and H₂O lasers.

Use of high-frequency pumping in place of pumping by direct-current discharge makes it possible to significantly increase the signal/noise ratio of submillimeter lasers [1-3]. Upon transition to high-frequency pumping, laser efficiency increases insignificantly, remaining relatively low—approximately 10^{-5} - 10^{-4} , while theoretically its limit (defined as the ratio of the energy of a photon to the energy of the upper laser level) is approximately 10^3 for lasers of this type. Thus there are great possibilities for improving this parameter. One of the most effective ways of solving this problem is to find a suitable buffer gas that shifts kinetic processes in the active medium in the required direction. In view of the diversity and complexity of these processes in submil-

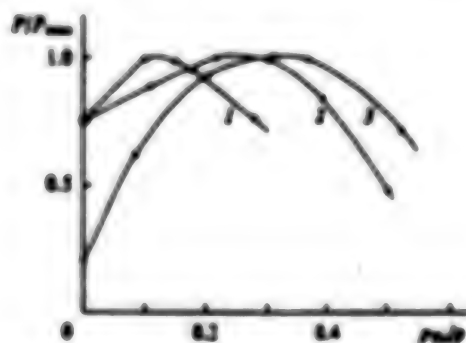
laser lasers, no theoretical work has been done on this subject yet, and experimental research continues to play the principal role.

Description of the Device

The experiments were conducted with a waveguide laser with structure described in detail in [1-3]. A high-frequency capacitive discharge (27.5 MHz) 2.2 m long in a glass tube with an inside diameter of 56 mm is the laser's active medium. By varying the length of the resonator, the laser was tuned to its most powerful, linearly polarized EH_{11} mode. A Cu-Ni mesh [1] was used as the semitransparent mirror in the HCN laser, while the den and H_2O lasers employed 100 percent mirror surfaces with an aluminum spray-coating and centrally positioned connective ports having various diameters d . The gas mixture was fed in continuously at one end of the tube, and pumped out by a backing pump at the other.

Experimental Results

HCN laser. Experiments with xenon in an HCN laser were described earlier in [1,4]. For a purpose of generality, we'll take them up again. The laser generates the highest output power, equal to 190 ± 10 mW, for the line having a wavelength of $\lambda = 336.8 \mu\text{m}$, as a result of the transition $11^0(J=10) \rightarrow 04^0(J=9)$, where the first three figures designate the vibrational quantum numbers, and J is the rotational quantum number of an HCN molecule [5]. Xenon increases the laser's output power and efficiency by 33 percent (see figure). A $C_2H_2N_2/Xe=19:10:8$ mixture, a working pressure of $p=0.9$ mm Hg, a mixture pumping rate of $S=0.2$ liters/min Hg/min, a pumping power of $P=1$ kW, and an optimum throughput for the mesh mirror of $\gamma=7$ percent, are optimum for laser operation.



Relationship between maximally normalized monochromatic output powers of H_2O (1), HCN (2) and DCN (emitting at λ_1) (3) lasers and the partial fraction of xenon in the gaseous mixture, for fixed (optimal) pumping powers

DCN laser. The operating mode of a DCN laser differs significantly from that of a HCN laser, because lasing occurs within it at different transitions [6]. The highest monochromatic output power of the laser was observed at the EH_{11} mode with $\lambda_1=189.95 \mu\text{m}$ as a result of the transition $22^0(J=22) \rightarrow 09^0(J=21)$ with simultaneous generation of a TE_{10} mode with $\lambda_2=194.76 \mu\text{m}$ at the cascade spin-spin transition $09^0(J=21) \rightarrow 09^0(J=20)$. The addition of xenon strongly affects the output power and efficiency of a DCN laser. As is evident from the figure, these parameters increase fivefold in the case of emission at $\lambda_1=189.95 \mu\text{m}$. The record monochromatic output power of 430 ± 22 mW exceeds by three times the same parameter for the best direct-current DCN laser with an active medium of the same length [7]. It was obtained chiefly due to use of xenon as a buffer gas. In this case the amplifying emission at the cascade transition with $\lambda_2=194.76 \mu\text{m}$ increases by a factor of 1.5. The total output power of the amplified (λ_1) and amplifying (λ_2) emissions is equal to 480 ± 34 mW. A $C_2D_2N_2/Xe=25:10:16$ mixture, $p=1.6$ mm Hg, $S=1.2$ liters/min Hg/min, $P=2.7$ kW, and $\gamma=5.1$ percent ($d=6.6$ mm) are optimal for the operation of a DCN laser.

H_2O laser. A mixture of water vapor and hydrogen is used in an H_2O laser [2,8] operating at the transition $001(J=5_1) \rightarrow 020(J=6_1)$ [9] with $\lambda=118.6 \mu\text{m}$. The addition of hydrogen, which was used for the first time by the authors of [10], doubles the laser's output power. We note that hydrogen, which is referred to in [10] as a "buffer gas," manifests itself more readily as a working component of the gas mixture. The mechanism by which laser power increases, linked to this addition, apparently consists of an increase in the rate of formation of excited H_2O molecules in the discharge out of atomic and molecular hydrogen, whose concentration increases. It is stated in [2,8] that pulsed addition of xenon to an optimal H_2O-H_2 mixture increased laser output power by another 30 percent for only the first few minutes after its input. As subsequently explained, that unexpected effect stemming from chemically inert Xe was associated with the fact that it contained a considerable admixture of atmospheric air. This admixture even precipitated a subsequent reduction of laser power to its initial level. Sufficiently pure industrial-grade Xe increases laser output power and efficiency by 33 percent in the standard mode (see figure). The maximum laser output power is equal to 62 ± 3 mW in this case. The optimum operating conditions are: an $H_2O-H_2/Xe=10:18:3$ mixture, $p=1.0$ mm Hg, $S=1.48$ liters/min Hg/min, $P=2.7$ kW, $\gamma=1.4$ percent ($d=3.4$ mm).

We note in conclusion that the effectiveness of xenon as a buffer gas in HCN, H_2O , and especially DCN lasers

achieved in this study makes it possible to recommend it for testing in other lasers operating at vibrational-rotational transitions.

Bibliography

1. Kubarev, V. V., PTE, No 3, 1986, p 177.
2. Kubarev, V. V. and Kurenskiy, Ye. A., KVANTOVAYA ELEKTRONIKA, Vol 22, 1995, p 1179.
3. Kubarev, V. V. and Kurenskiy, Ye. A., "Proc. of Intern. Symp. "Modern Problems of Laser Physics," Novosibirsk, Russia, 1995.
4. Kubarev, V. V., Preprint, Institute of Nuclear Physics, Siberian Division, Academy of Sciences, No 84-09, Novosibirsk, 1984.
5. Lide, D. R. and Maki, A. G., APPL. PHYS. LETTS., Vol 11, 1967, p 62.
6. Maki, A. G., APPL. PHYS. LETTS., Vol 12, 1968, p 122.
7. Belland, P. and Veron, D., IEEE J. "Quantum Electron," Vol 16, 1980, p 885.
8. Kubarev, V. V. and Kurenskiy, Ye. A., Preprint, IYAF SO Russian Academy of Sciences, No 95-38, Novosibirsk, 1995.
9. Pollack, M. A. and Tomlinson, W. J., APPL. PHYS. LETTS., Vol 12, 1968, p 173.
10. Dyubko, S. F., Svich, V. A. and Valitov, R. A., Journal of Theoretical Physics, Vol 38, 1968, p 1988.

Russia: Use of Cultured Fibroblasts to Restore Skin Surfaces of Severe Burn Victims

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EKSPERIMENTALNOY BIOLOGII I MEDITSINY

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[Article by D. S. Sarkisov, V. D. Fedorov, Ye. V. Glushchenko, A. A. Alekseyev, V. P. Tumanov, G. G. Serov, S. I. Vozdvizhenskiy and L. I. Budkevich, Institute of Surgery imeni A. V. Vishnevskiy, Russian Academy of Medical Sciences]

[FBIS Translated Text] A fundamentally new method with no analogues in world practice has been developed for treating skin burns by transplantation of cultured cells onto the wound surface. Instead of keratinocytes, human allofibroblasts are used as the main transplant element. Experience in using this method on 222 severe burn victims, including following early surgical necrectomy, showed that the method is an effective means of treating degree III "borderline burns." Researchers managed to reduce wound epithelialization time from 31 \pm 2 to 8.4 \pm 0.9 days. When this method was combined with an autodermoplastic reticular skin flap with 1:6 perforation, the wound epithelialization time decreased in the presence of deep degree IIIB-IV burns from 20 \pm 2.3 to 12 \pm 1.3 days. The method's high effectiveness in treating long-healing wounds on the donor area is demonstrated. The proposed method's high effectiveness, its significantly lower cost in comparison with others due to exclusion of expensive nutrient media and growth biostimulators from the treatment cycle, as well as the sharp decrease in the time it takes to obtain a transplant from allofibroblasts (to 3 days), makes its introduction into regular clinical practice suitable.

Key words: fibroblast culture, treatment of severe burn victims

Restoring skin surfaces is one of the most important problems of treating patients with extensive and deep burns. Autodermal plastic surgery with a split and perforated skin flap is extremely effective in this respect. However, the surgeon is often faced with a shortage of skin from the patient's own body. The existing means of temporarily covering burn surfaces—with cadaver allografts, xenografts, amniotic membrane and synthetic materials—cannot solve these problems and do not exclude use of an autograft [13,15,24].

P. B. Medowar demonstrated the fundamental possibility of growing keratinocytes *in vitro* [20]. The first reports of successful use of cultured keratinocytes to treat burn victims appeared in 1981-1982 [12,14,22]. Cultured keratinocytes subsequently came into use in the

treatment of long-healing donor wounds, and to close wound defects upon removal of giant birthmarks, tattoos and trophic ulcers [19,25,27]. Over 100 papers pertaining to acquisition, procedures, and results of using cultured cells to restore skin surfaces were presented at the Ninth International Burn Trauma Congress, held in Paris in June 1994.

Two basic directions have formed in the field of clinical use of cultured cells. The first has to do with use of sheets of cultured keratinocytes, obtained most often from autocytes [13,16,28] and more rarely from allokeratinocytes [17], to cover burn surfaces. The second direction concerns itself with covering wound surfaces with so-called viable skin equivalents, which include not only cultured keratinocytes but also a dermal equivalent consisting of collagen, glycosaminoglycans and single fibroblasts [11,21].

However, a number of shortcomings revealed themselves in the very first phases of clinical application of grafts from cultured keratinocytes that hindered their wide clinical use. A cell bank cannot be created when autokeratinocytes are used. The time needed to make a graft of sufficient area is long—3-4 weeks; the long time of graft acquisition dramatically increases the risk of development of complications of burn disease and lengthens the patient's hospital stay. For practical purposes, autokeratinocytes do not take when transplanted to granulated burns. Special growth media and biologically active keratinocyte growth stimulators are expensive, as a result of which the cost of 200 cm² of cultured keratinocytes is US\$13,000. It should be emphasized that the results of using cultured cells depend to a significant degree on the preparedness of the burn itself for grafting. In cases where cultured cells are grafted to the wound surface following surgical necrectomy, not more than 30-80 percent of the area of transplanted cells takes [16,23,26]. This percentage drops to 15 in the case of granulated wounds [17].

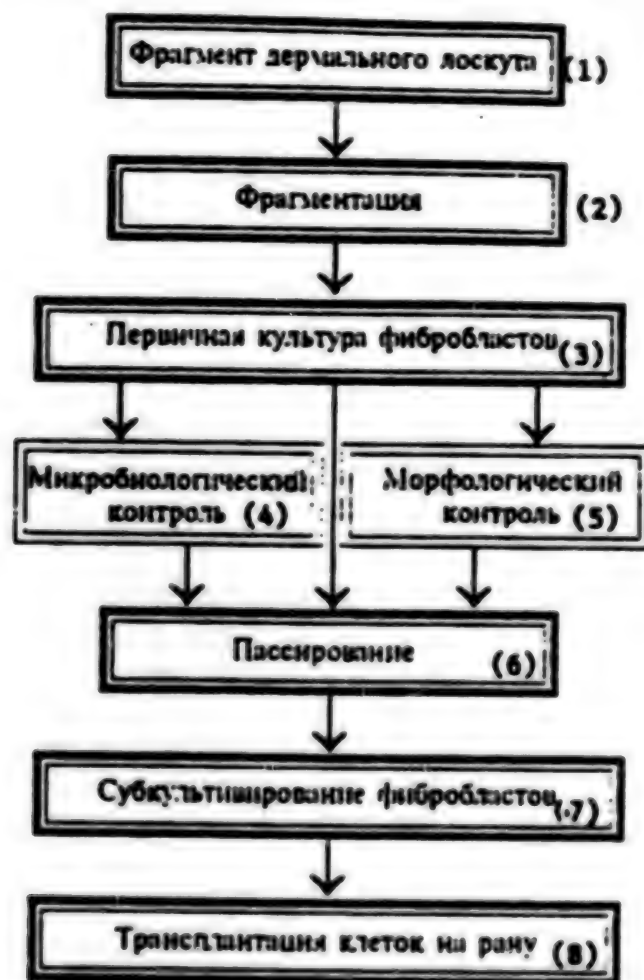
Thus modern methods of local treatment of burns based on using a transplanted flap of cultured keratinocytes as the main component have significant shortcomings making their wide introduction into clinical practice difficult.

In order to surmount these difficulties the Institute of Surgery imeni A. V. Vishnevskiy of the Russian Academy of Medical Sciences developed an original and effective method of covering a wound surface with cultured cells. This method differs fundamentally from all others known in world practice in that fibroblasts

were used for the first time rather than keratinocytes as the main component of the cultured cell sheet [2,7-10]. The work was based on the results of our electronic autoradiographic research on granulated tissue, in which we established that pericytes surrounding tiny vessels are polypotent mesenchymal cells transforming into fibroblasts [3-6]. The latter have a strong stimulatory influence on proliferation and adhesion of keratinocytes.

Use of cultured fibroblasts to cover wound surfaces has a number of advantages over cultured keratinocytes. In particular, acquisition of fibroblasts in culture does not

require expensive nutrient media or growth stimulators. This decreases the cost of 200 cm² (an area equal to 1 percent of the body surface) to US\$120—that is, by more than 100 times compared to keratinocytes; fibroblasts in culture undergo passage more easily; during passage, fibroblasts partially lose the surface antigens determining histocompatibility, which creates a possibility for using allocells to make grafts and to create cell banks; the time it takes to obtain grafts ready for clinical use is reduced from 3 weeks (for keratinocytes) to 2-3 days (for fibroblasts).



Stages of Acquisition of Human Cultured Fibroblasts to Cover Burns

Key: —1. Dermal flap fragment; —2. Fragmentation; —3. Primary fibroblast culture; —4. Microbiological control; —5. Morphological control; —6. Passage; —7. Fibroblast subculture; —8. Transplantation of cells to wound

The fibroblasts in such grafts proliferate actively, and synthesize collagen, fibronectin and glycosaminoglycans, which enter into the composition of the extra-

cellular matrix formed by cells [2]. Components of extracellular matrix—collagen and fibronectin—stimulate both keratinocyte adhesion and cell proliferation [1].

Concurrently fibroblasts are a necessary factor *in vitro* for differentiation of the latter and formation of intracellular links with keratinocytes.

The procedure we developed consists of the following. A primary human fibroblast culture is obtained in the first stage by fragmentation and enzymatic treatment of dermis. The primary fibroblast culture is passaged and subjected to four- to seven-time subculturing. The last subculturing is carried out on a membrane, on which the culture is then transplanted to the wound. Fibroblasts are cultured in all stages in Eagle's medium containing 10 percent embryonic calf serum and 2 percent glutamine using a CO₂ incubator (see diagram).

Clinical research showed that transplantation of cultured human fibroblasts is an extremely effective means of local treatment of extensive "borderline" degree III burns, extensive degree IIIB-IV burns (combined with dermatoautoplasty with a perforated 1:6 skin flat in adults and 1:4 in children), and long-healing wounds in donor areas after dermatoautoplasty.

The total number of burn victims treated with cultured fibroblasts was 222. The results of traditional treatment of 67 severe burn victims were used as the control.

Wound healing dynamics were assessed by means of cytological and morphological methods, including qualitative and quantitative analyses of wound smears and prints, and autoradiographic, electromicrographic and histological analysis of wound biopreparations.

Transplantation of cultured fibroblasts to burns was preceded by comprehensive treatment to prepare the patient and the wounds for surgery. The patients were subjected to commonly accepted treatment, including antishock therapy, and treatment of acute burn toxemia and septicotoxemia. Local treatment foresaw formation of a burn scab followed by necrectomy. A 1 percent iodopyrone solution was used as a rule to form the burn scab. Following necrectomy, further preparation of the wound for transplantation of cultured fibroblasts was carried out using state-of-the-art polyethylene glycol-based ointments—Levosin, Levomikol and 5 percent dioxydine, and perforated xenografts. Patients were treated using a Klinotron fluoridation bed when extensive circular burns of the torso and limbs were present. This made it possible to mummify the burn scar faster, reduce burn intoxication, and create abacterial conditions for wound treatment both in the pre- and in the postoperative period. Granulating wounds with bacterial contamination not exceeding 10⁴ microbial bodies per gram formed as a result. Directly prior to transplantation of the fibroblasts, the wound surface was washed with 3 percent hydrogen peroxide solution. Every graft was secured to the wound surface with paraffinated gauze. Synthetic backings were removed 2-3 days after transplantation. Polyethylene glycol-based ointments were used subsequently in the treatment of degree III borderline burns until complete epithelialization of the wounds.

Dermatoautoplasty combined with transplantation of a fibroblast culture was carried out in the case of deep degree IIIB-IV burns. Following the necessary therapy, necrectomy, fibroblast transplantation and removal of the synthetic backing, plastic closure of wounds was carried out in adults with a reticular dermal autograft with 1:6 perforation. In children, allofibroblasts were grafted not to granulating wounds but to the wound surface formed after excision of the burn scab in the early period after injury, followed by deferred dermatoautoplasty using a graft with a stretch factor of 1:4. Owing to the capability fibroblasts have for actively stimulating adhesion and proliferation of keratinocytes, despite the high degree of perforation the autograft took quickly and effectively.

The group of patients with extensive "borderline" degree III burns consisted of 27 persons from 3 to 43 years old. The area of simultaneous fibroblast grafting reached 900 cm².

Complete epithelialization of wounds covered with cultured fibroblasts was observed in 25 patients (92.6 percent). In this case the average healing time was 8.4 +/- 0.9 days. Epithelialization was not observed in two patients (7.4 percent). This was associated with presence of deep degree IIIB burns on them. Epithelialization of burns in the control groups of patients was not noted in a single case within this time. In these patients, healing of wounds from borderline degree III burns occurred an average of 31 +/- 2 days after injury.

The following wound dynamics were noted in patients with a favorable outcome of fibroblast grafting. Prior to transplantation of the cultured fibroblasts, the wound was characterized by a bleeding granulated surface covered in places with fibrin. Areas of epithelialization were absent. Cytochrome proved the wounds to be of the inflammatory and, more rarely, of the inflammatory-regenerative type. Microscopic inspection revealed immature granulated tissue profusely infiltrated with leukocytes in the wound.

Following transplantation of the fibroblast culture (on the third day) onto the wound surface, formation of a mate film was observed. Granulations appeared lower compared to control areas, and there was no bleeding from them; changing of dressings became painful. Cytological analysis indicated a shift in the cytogram from inflammatory to regenerative. Maturer granulations were observed in the wound microscopically, together with appearance of collagen fibers with significantly less-pronounced leukocytic infiltrates.

By the end of the 7th day centers of epithelialization appeared, and by the 10th-14th days formation of a flat multilayered epithelium was noted over the entire surface of the wound. All of its layers and the basal membrane were distinct. However, the papillar layer of the dermis appeared unformed. Autoradiographic and electromicrographic investigations revealed a high

level of DNA synthesis in basal cells of the forming epithelium, and high proliferative activity of dermal fibroblasts.

Observation of the newly formed skin surfaces over the next 18 months indicated that they were in good condition.

The second group contained 77 adult patients and 18 patients from 1 to 6 years old with extensive, deep degree IIIB-IV burns.

The burn area on adults was from 30 to 70 percent of the body surface, while the total graft area was from 500 to 5,000 cm². When cultured fibroblasts were used in combination with 1:6 perforated autografts, the wound epithelialization time in patients with extensive, deep degree IIIB-IV burns was 12 +/- 1.32 days. In this case lysis of the graft was not observed on any of the subjects. In the control group, taking of an autograft with 1:6 perforation occurred in an average of 20 +/- 2.3 days, while the maximum wound epithelialization time reached 36 days. Concurrently we observed partial lysis of transplanted autografts in 30 percent of the cases in the control group.

In children, the total burn area was from 5 to 80 percent, and the wound surface covered by fibroblasts was from 30 to 3,000 cm². Wound healing occurred in 7-10 days when a combination of plastic surgery and fibroblast cultures was used. In this case a reticular pattern was hardly noticeable on the skin graft, which distinguished these patients from control observations. The grafts were observed to take over an area equal to 84 percent of the grafted area. The average time patients of this group remained in the hospital was 18.5 days (22.4 days in the presence of burn disease, and 14.6 days in the case of local burns). The average hospital time of patients with extensive, deep burns (over 50 percent of the body surface) was 59.3 days (three children).

The third group consisted of 38 severe burn victims with long-healing wounds in donor areas following removal of skin for dermatomeplasty. The average time from the moment donor skin was removed to transplantation of the cells (the time during which healing was absent) was 50.1 +/- 18.5 days. Antibacterial treatment once again preceded transplantation of fibroblasts to nonhealing wounds in donor areas. By the 10th day after transplantation of cultured fibroblasts, complete wound epithelialization was noted in 37 of 38 of these patients (an average of 6.7 +/- 0.87 days). In the control group the average epithelialization time of such wounds, which received continuing local treatment by traditional methods, was 44 +/- 4.6 days.

The results of dynamic cytological and histological control showed that transplantation of fibroblasts promotes a rapid succession of phases of inflammation. By as early as the third or fourth day after transplantation, fibroblasts dominate among cells in cytogrammic prints taken from the wound surface. By the 7th day their concentration reaches 42 percent. The number of polynuclear leukocytes decreases quickly in this case. Concurrently with this, domination of fibroblasts over all other types of cells is also noted in the cellular composition of granulated tissue, which was not recorded in control observations. Epidermis forming after transplantation of fibroblast cultures is characterized by irregular thickness, distinct differentiation of all layers, and arrangement of cells of the basal layer in one or two rows.

We thus developed a fundamentally new method, with no analogues in world practice, of treating skin burns by transplanting cultured cells to the wound surface. It differs from all others in that fibroblasts are used rather than keratinocytes as the main element of the graft (see table).

Comparative Assessment of the Results of Using Cultured Human Cells to Treat Burn Victims

Compared indicators	Keratinocytes (published data)	Fibroblasts (our observations)
Total number of observations	300 [16]	222
Burn area, % of body surface	10-85 [16,23,26]	II-75
Burn depth, degree	III-IV [16,18,23,26]	III-IV
Total area of transplanted grafts, % of injured body surface	0.4-39 [23,26]	0.2-55
Maximum area of simultaneously transplanted cellular sheets, cm ²	1,850 [23]	3,000
Graft take rate, %	15-80 [16,17,23]	84-100
Cost of graft (with burns on 4-55% of body surface, US\$)	9,800-181,000 [23]	480-4,000

In the case of degree III borderline burns and wounds on donor areas that do not heal for a long time, transplantation of fibroblasts stimulates proliferation of islets of epidermis surviving after injury. In the case of deep degree IIIB-IV burns, in the huge number of cases when total destruction of the epidermis does not occur, there is no need for extremely laborious and rarely successful culturing of epidermocytes and their transplantation to the skin surface. The high effectiveness of the proposed method, its significantly lower cost due to exclusion of expensive nutrient media and growth biostimulators from the production cycle, and dramatic reduction of the time it takes to obtain an autologous skin graft (to 3 days) make its introduction into regular clinical practice suitable.

Bibliography

1. Glushchenko, Ye. V., Tumanov, V. P., Serov, G. G. and Pal'syn, A. A., *BYUL. EKSPER. BIOL.*, Vol 16, No 11, 1993, pp 541-544.
2. Glushchenko, Ye. V., Alekseyev, A. A., Tumanov, V. P. and Serov, G. G., *ARKH. PAT.*, No 5, 1994, pp 29-34.
3. Sarkisov, D. S., Kostyuchenok, B. K., Amirailanov, Ya. A. et al., *BYUL. EKSPER. BIOL.*, Vol 98, No 7, 1984, pp 97-99.
4. Sarkisov, D. S., Pal'syn, A. A. and Kolokolchikova, Ye. G., *ARKH. PAT.*, No 9, 1984, pp 16-24.
5. Sarkisov, D. S., Kolokolchikova, Ye. G. and Pal'syn, A. A., *BYUL. EKSPER. BIOL.*, Vol 103, No 6, 1987, pp 730-732.
6. Sarkisov, D. S., Pal'syn, A. A., Muzykant, L. I. et al., in Kuzin, M. I. and Kostyuchenok, B. M. (Editors), "Rany i ranevaya infektsiya" [Wounds and Wound Infection], Moscow, 1990, pp 38-86.
7. Sarkisov, D. S., Tumanov, V. P., Glushchenko, Ye. V. et al., *BYUL. EKSPER. BIOL.*, Vol 109, No 3, 1990, pp 400-402.
8. Sarkisov, D. S., Glushchenko, Ye. V., Tumanov, V. P. et al., *BYUL. EKSPER. BIOL.*, Vol 111, No 5, 1991, pp 542-544.
9. Sarkisov, D. S., Alekseyev, A. A., Tumanov, V. P. et al., *KHIRURGIYA*, No 3, 1993, pp 22-26.
10. Fedorov, V. D., Sarkisov, D. S., Tumanov, V. P. and Glushchenko, Ye. V., *VRACH*, No 11, 1993, pp 26-28.
11. Asselineau, D., Bernard, B., Bailly, C. et al., *J. INVEST. DERMATOL.*, Vol 86, 1986, pp 181-186.
12. Bell, E., Ehrlich, H. P., Buttle, D. and Nakatsuji, T., *SCIENCE*, Vol 211, 1981, pp 1052-1054.
13. Bell, E., Sher, S., Hull, G. et al., *J. INVEST. DERMATOL.*, Vol 81, No 1, 1983, pp 2-10.
14. Burke, J. F. and Yannas, I. V., *AMER. SURG.*, Vol 194, 1981, pp. 413-428.
15. Cohen, I. K., McCoy, B. I. and Diegelmann, R. F., *ANN. PLAST. SURG.*, Vol 3, No 3, 1979, pp 264-272.
16. Comton, C. C., Gill, G. M., Bradford, D. A. et al., *LAB. INVEST.*, Vol 60, No 5, 1989, pp 600-611.
17. De Luca, M., Albanese, E., Bondanza, S. et al., *BURNS*, Vol 15, 1989, pp 303-309.
18. Gallico, G. G. and O'Connor, N. E., *CLIN. PLAST. SURG.*, Vol 12, No 2, 1985, pp 149-157.
19. Koga, M., *ARCH. DERMATOL.*, Vol 124, No 11, 1988, pp 1656-1658.
20. Medowar, P. B., *NATURE*, Vol 148, 1941, pp 783-784.
21. Nanchahal, J., Dover, K., Otto, W. R. and Dhital, S. K., *LANCET*, July 22, 1989, pp 191-193.
22. O'Connor, N. E., Mulliken, J. B., Banks-Schlegel, S. et al., *LANCET*, Jan. 10, 1981, pp. 75-78.
23. Rue, L. W., Cioffi, W. G., McMamas, W. F. et al., *J. TRAUMA*, Vol 34, No 5, 1993, pp 662-669.
24. Salisbury, R. E., Wilmore, D. W., Silverstein, P. et al., *ARCH. SURG.*, Vol 106, 1973, pp 705-707.
25. Teepe, R., Kreis, R. W., Koeburges, E. J. et al., *J. TRAUMA*, Vol 30, No 3, 1990, pp 269-275.
26. Teepe, R., Koeburges, E. and Poncet, M., *BRIT. J. DERMATOL.*, Vol 122, 1990, pp 81-89.
27. Thivolet, J., Faure, M., Demodet, A. and Mauduit, G., *BULL. ACAD. NATL. MED. (Paris)*, Vol 170, No 4, 1986, pp 556-562.
28. Tumanov, V. P., Pal'syn, A. A. and Sarkisov, D. S., *ACTA CHIR. PLAST.*, Vol 31, 1989, pp 14-20.

Armenia: Natural Amino Acid Derivatives in the Role of Radioprotectors (Review)

964DX654A Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Jul 95 Vol 29 No 7, pp 11-15

[Article by S.A. Kazaryan, K.P. Grigoryan, S.N. Ayrapetyan, and O.L. Mndzhoyan, Fine Organic Chemistry Institute imeni A.L. Mndzhoyan, Republic

of Armenia National Academy of Sciences, Yerevan; manuscript received 2 Dec 94)

[FBIS Summary] Judging by the literature published from 1950 through 1992, the problem of finding new radioprotectors based on natural amino acid has attracted a great deal of attention. The first mention of an amino acid with a radioprotective effect occurred in 1949, when L-cysteine in doses of 500 and 820 mg/kg was reported to have a slight protective effect in dogs subjected to x-radiation. Studies published in the 1950s and 1960s noted that the D-isomer of cysteine had more of a radioprotective effect than the L-isomer, most likely because the D-isomers are metabolized more slowly than L-isomers. In 1972, Japanese scientists conducted an in-depth study of the radioprotective effect of the ethyl ether of cysteine when administered both intraperitoneally and orally. It proved less toxic than cysteine and produced a similar effect; however, it did not protect mice against an absolutely lethal dose of radiation. Of a series of complex cysteine derivatives later studied, only α -mercaptopropionylglycine had a moderate radioprotective effect. Homocysteine has been shown to be an active radioprotector, whereas methionine and β -homocysteine have been shown to have no radioprotective effect. N-acetylcysteine was shown to have a moderate radioprotective effect by two teams of scientists. V.G. Yakovlev et al. established the radioprotective effect of a number of mercaptoethylamine derivatives that had been acylated at the mercapto group with amino acids (glycine, alanine, etc.). The said compounds proved less toxic than mercaptoethylamine while providing the same radioprotective effect (albeit at much higher doses). Glutathione and its monomethyl and diethyl ethers have been shown to be active radioprotectors in mice and rats, and S-alkyl-L-cysteine and S-alkyl-2-methyl-D, L-cysteine have been demonstrated to be more active than L-cysteine. Sulfate, amidine, diethylthiocarbamate, and phosphate derivatives of α -mercaptopropionylglycine have been established to have a moderate radioprotective effect. Several teams of scientists have studied the radioprotective effect of compounds based on adenosine triphosphate and 2-aminoethylisothiuronium. Between 80 and 96 percent of mice injected with 3-(2-mercaptoethyl) aminopropionamide and 75 percent of mice injected with 3-(3-mercaptoethyl) aminopropionamide hydrobromide survived subsequent irradiation. Data regarding the radioprotective effect of tryptophan are contradictory. Studies of α - and β -phenylethylamines and β -phenyl- α -alanine have indicated that they do not have any radioprotective effect. In tests examining their radioprotective effect on mice, four of 13 new derivatives of glutamic acid resulted in a 30-50 percent survival rate. All four derivatives contain a piperidine radical in different positions

of the glutamic acid. Zinc, magnesium, and potassium salts of aspartic acid and potassium and magnesium aspartates have been reported to have radioprotective effects. γ -L-glutamyltaurine (litalon) and its analogues and γ -aminobutyryltaurine and its phosphoric analogue have also been reported to have a radioprotective effect. Several zootoxins, including the whole venom of several Central Asian snakes, have also been found to contain protein components with some radioprotective effect. References 125: 50 Russian, 75 Western.

Ukraine: Synthesis and Anticarcinogenic Activity of *bis*-([μ (2-Amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide) platinum (2⁺))

964D0654B Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Jul 95 Vol 29 No 7, pp 15-18

[Article by L.I. Volchenkova, L.V. Keyseyevich, and S.A. Shalimov, Ukrainian Scientific Research Institute of Oncology and Radiology, Kiev; manuscript received 23 Aug 94]

[FBIS Summary] *bis*-([μ (2-Amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide)platinum(2⁺)) was synthesized, and its anticarcinogenic properties were studied. In the new compound, two molecules of 2-amino-6-oxypurine (guanine) act as bridges located between two *cis*-PtCl₂(dimethyl sulfoxide [DMSO]) in a "head-to-tail" arrangement, with each molecule of 2-amino-6-oxypurine (guanine) bound with the metal through N and OC atoms. The DMSO molecule is attached to the platinum through the sulfur atom. *bis*-([μ (2-Amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide) platinum (2⁺)) was found to have a solubility exceeding 1.7 mol/l, whereas 2-amino-6-oxypurine (guanine) has a solubility of just 0.07 mol/l. Solutions of *bis*-([μ (2-amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide) platinum (2⁺)) in DMSO conducted virtually no electric current. The new compound's structure was confirmed by mass spectrometry under conditions of bombardment with fast ions and by infrared and nuclear magnetic resonance spectroscopy (¹H, ¹³C, ¹⁹⁵Pt). A molecular ion was discovered and determined to be a protonated molecule of *bis*-([μ (2-amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide) platinum (2⁺)), and dimeric and monomeric fragments were discovered that were determined to be products of the molecule's decomposition on account of breaking of the Pt-DMSO, Pt-Cl, Pt-Gu, and C-C and C-N bonds of coordinated 2-amino-6-oxypurine (guanine). *bis*-([μ (2-Amino-6-oxypurine)](*cis*-dichloro)(dimethylsulfoxide) platinum (2⁺)) was demonstrated to be nontoxic to nonpedigree female rats (weight, 100-120 g) when administered in one-time doses of 200, 400, 600, 800,

and 1,000 mg/kg. The new compound's anticarcinogenic activity was studied in a model of breast cancer chemically induced by DMBA. Sixty 6-week-old rats were divided into four groups. Each rat was injected with 2 mg DMBA in 0.1 ml DMSO three times at 3-day intervals. Three groups of rats also received injections of either *bis*-(μ (2-amino-6-oxypurine))(*cis*-dichloro)(dimethylsulfoxide)platinum(2⁺)) (100 mg/kg) or a platinum complex daily for 10 days. Six months after the rats had been injected with the DMBA, tumors of the breast developed in 65.8 \pm 2.1 percent of the controls, 65.0 \pm 2.1 percent of the rats receiving just DMSO in addition to the DMBA, 57.0 \pm 1.9 percent of the rats receiving the platinum complex, and only 28.9 \pm 1.8 percent of the rats receiving the *bis*-(μ (2-amino-6-oxypurine))(*cis*-dichloro)(dimethylsulfoxide)platinum(2⁺)). Tables 2; references 14: 8 Russian, 6 Western.

Russia: Synthesis and Pharmacologic Properties of 4(5)-Substituted 5(4)-Amidino-1,2,3-Triazoles

964D0654C Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL

in Russian Jul 95 Vol 29 No 7, pp 18-21

[Article by M.P. Nemeryuk, A.L. Sedov, T.S. Safonova, G.Ya. Shvarts, I.F. Payermark, and M.D. Mashkovskiy, TxKhLS (not further identified), All-Russian Scientific Research Institute of the Chemical-Pharmaceutical Industry imeni Sergo Ordzhonikidze; manuscript received 1 Mar 94]

[FBIS Summary] Eight series of 4(5)-substituted 5(4)-amidino-1,2,3-triazoles were synthesized by diazotizing eight 4-dialkylamino-5-aminopyrimidines in a medium of aqueous hydrochloric acid as described elsewhere. The proposed synthesis process was said to be convenient from a preparation standpoint, result in rather high yields of end products, and permit variation of the nature of the substituents both in the triazole ring and in the amidine grouping within a rather wide range. The new 4(5)-substituted 5(4)-amidino-1,2,3-triazoles' acute toxicity was tested in male mice weighing 18-20 g each, their effect on arterial pressure was studied in anesthetized normotensive male rats weighing 220-250 g each by injecting the compounds into the rats' jugular vein in doses of 0.1 to 10 mg/kg and directly recording the pressure in their carotid artery, and their effect on arterial pressure when injected into spontaneously hypertensive rats was studied indirectly by a using a photoelectric transducer to record arterial pressure. The compounds' effect on the pain response was studied in mice that were subjected to thermal and chemical nociceptive stimulation and then injected with 50 or 100 mg/kg of the study compounds, and their anti-inflammatory effect was stud-

ied on a model of acute peritonitis induced in mice by the intraperitoneal injection of a 1 percent solution of acetic acid in a 0.25 ml per animal. All eight 4(5)-substituted 5(4)-amidino-1,2,3-triazoles were found to have a low toxicity: Toxic effects were only observed when the compounds were administered in a dose of 1,000 mg/kg, and all the toxic effects observed (mainly light tremor and adynamia) in the mice after administration of the new compounds disappeared by themselves within 2-3 hours. Four of the eight compounds had a hypotensive effect; however, it lasted only briefly (3 hours or less). The most active of the new compounds (i.e., the compound characterized by the empirical formula $C_7H_{11}Cl_2N_5O$) had a hypotensive effect in doses as low as 10 mg/kg. None of the compounds had an antinociceptive or anti-inflammatory effect. It was concluded that in order for 4(5)-substituted 5(4)-amidino-1,2,3-triazoles to have an antihypertensive effect, they must contain Cl atoms either directly in the fifth position of the cycle or in a substituent bound to that position of the triazole ring. The nature of the substituents in the carbamidine portion of the molecule had no significant effect on biological activity, although the presence of a morpholine cycle in the amidine fragment resulted in more pronounced antihypertensive activity. Tables 2; references 16: 3 Russian, 13 Western.

Russia: Synthesis and Antimicrobial Activity of Coordination Compounds of 3d-Elements With Products of the Condensation of 5-Nitrofurfural Semicarbazones and Aromatic (Heterocyclic) Aldehydes

964D0654D Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL

in Russian Jul 95 Vol 29 No 7, pp 21-24

[Article by V.I. Tsapkov, N.M. Samus, N.G. Velishko, V.G. Bodayu, and S.A. Buracheva, Moldovan University, Kishinev; manuscript received 25 Feb 93]

[FBIS Summary] Complexes of oxovanadium (4+), manganese (2+), iron (2+), cobalt (2+), nickel (2+), copper (2+), and zinc with products of the condensation of 5-nitrofurfural semicarbazone and 2-oxy-1-benz or 2-oxy-1-naph, 3-pyridine, or 4-pyridine aldehydes were synthesized in an attempt to find new antimicrobial agents. A total of 16 compounds were synthesized and tested. Museum cultures of gram-positive (*Staphylococcus aureus* strain Wood 46, *Bacillus anthracis* strain ST1) and gram-negative (*Escherichia coli* strain M-17, *Proteus vulgaris*, and *Salmonella typhimurium*-1) served as test microbes in the in vitro experiments performed to determine the new compounds' antimicrobial activity. Antimicrobial activity was evaluated by the method of successive dilution of the compounds by half in meat-

infusion broth. All of the study compounds manifested antimicrobial activity against the test microbes in concentrations of 6.25-300 $\mu\text{g/ml}$. The compounds were more effective against the gram-positive test microbes than they were against the gram-negative test microbes. Against the gram-positive test microbes, the new compounds had minimum inhibitory concentrations (MICs) and minimum bactericidal concentrations (MBCs) ranging from 6.25 to 75 $\mu\text{g/ml}$. Against the gram-negative test microbes, on the other hand, the MIC and MBC of the new complexes ranged from 6.25 to 300 mg/ml . Of all the test microbes used, the anthrax strain ST1 was the most sensitive to the new complexes. *S. typhimurium* and *E. coli* were also highly sensitive to the new complexes. The nature of the new complexes' central ion had a big effect on their MIC and MBC: Given one and the same Schiff base, the effect of the central ion on MIC and MBC may be described by the following relationships: $\text{Cu} \leq \text{Co}$, $\text{Ni} \leq \text{Zn}$, and Mn and $\text{V} \leq \text{Fe}$. The nature of the Schiff base also affected the MIC and MBC of the newly synthesized compounds. Tables 2; references 6 (Russian).

Russia: Study of Bufadienolides of the Skin Secretion of Green Toads (*Bufo viridis* Laur, 1758)

964D0654E Moscow
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Jul 95 Vol 29 No 7, pp 41-43

[Article by LM. Gepla, D.A. Shabanov, D.A. Leontyev, M.G. Levin, O.V. Shishkin, V.N. Baumer, and Ye.Ye. Lakin, Kharkov State University; manuscript received 3 Feb 94]

[FBIS Summary] The composition of the skin secretion of the green toad (*Bufo viridis*) inhabiting Kharkov Oblast was examined in view of the reported cardiotonic and local anesthetizing activity of natural bufadienolides. Nine bufadienolides were extracted from the steroidal fraction of the toads' skin secretion by column and preparative high-performance liquid chromatography. The paramagnetic resonance (PMR) spectra of all nine compounds included the characteristic signals of protons of the pyrone cycle in the interval from 6.2 to 7.8 ppm. The first of the nine compounds was determined to have the composition $\text{C}_{28}\text{H}_{42}\text{O}_5$ ($\text{MH}^+ = 387$); its PMR spectrum coincided with that of bufalin. The second of the compounds was determined to have the composition $\text{C}_{28}\text{H}_{42}\text{O}_5$ ($\text{MH}^+ = 401$). Compounds 3, 4, and 5 had the composition $\text{C}_{28}\text{H}_{42}\text{O}_5$ ($\text{MH}^+ = 403$), and all were trihydroxy compounds. Compound 3 was determined to have only one secondary hydroxyl group and was deemed telocinobufagin [as published]. X-ray crystallographic analysis confirmed compound 4 to be gammabufotalin. Compound 5 was determined to be 19-

hydroxybufalin. Compounds 6 through 9 were determined to have the composition $\text{C}_{28}\text{H}_{42}\text{O}_5$ ($\text{MH}^+ = 417$). The nine compounds extracted from the toad's skin secretion were used as markers in developing a method for chromatographic analysis of the total extract of *Bufo viridis* secretion. Figure 1; table 1; references 13; 2 Russian, 11 Western.

Russia: Mycelium Extract From the Fungus *Pythium ultimum*—An Effective Means of Protecting Potatoes Against Phytofluorosis

964D0653A Moscow MIKROBIOLOGIYA in Russian
Vol 64 No 4, Jul-Aug 95 pp 497-499

[Article by M.A. Kuznetsova, L.A. Shcherbakova, L.I. Ilinakaya, A.V. Filippov, and O.L. Ozeretskoykaya, All-Russian Scientific Research Institute of Phytopathology, Bolshiye Vyazemy, and Biochemistry Institute imeni A.N. Bakh, Russian Academy of Sciences, Moscow; manuscript received 14 Jun 94; UDC 577.19:582.28]

[FBIS Summary] The ability of isopropanol extracts of mycelium from the fungus *Pythium ultimum* to protect 7- to 8-day-old seedlings of two varieties of potatoes (Fresco and Temp) against phytofluorosis was studied in experiments conducted on potato seedlings and potato and tomato leaves that had been infected with *Phytophthora infestans*. The antiphytofluorosis activity of the *P. ultimum* extract was compared with that of the contact chemical khometain and the well-known biological preparations rizoplan and baktofit. The optimum age of *P. ultimum* cultures from the standpoint of accumulation of metabolites with a protective effect was determined, and the protective effects of extracts from 3-, 5-, and 7-day-old mycelium were compared in studies performed on tomato leaves exposed to *P. infestans*. Each experiment was repeated three times. The potato seedlings were treated twice (at a 7-day interval) with a *P. ultimum* extract that was obtained from a submerged culture of *P. ultimum* by boiling the mycelium with 50 percent isopropanol. Just a single application of the extract in a 1:10 dilution reduced the infection of isolated potato leaves by a factor of 23 as compared with the rate of infection of the control leaves. The extract's effectiveness in preventing infection decreased as the dilution of extract applied to the leaves was increased (to 1:10,000). Even at so high a dilution, however, the extract still provided a statistically significant degree of protection provided that the leaves were not exposed to *P. infestans* until 48 hours after they had been treated with the *P. ultimum* extract. The maximum degree of protection was obtained with extracts from 3-day-old mycelium in a 1:10 dilution. In addition, treating isolated potato leaves with the *P. ultimum* extract suppressed the phytofluoro-

sis pathogen's ability to form spores, although it did not significantly affect the diameter of the necroses that formed on the leaves that became infected. Field treatment of growing potato plants with the *P. ultimum* extracts four times proved an effective means of protecting the plants. The extract's effectiveness in protecting potato plants against phytofluorosis was nearly identical to that of khometain and comparable to the effects of baktoft and rizoplan. The *P. ultimum* extract was concluded to be an economically feasible means of protecting plants against phytofluorosis in view of the simplicity and relatively low cost of producing the extracts and the availability of *P. ultimum*. Tables 2; references 5: 3 Russian, 2 Western.

Russia: Sulfate-Reducing Bacteria From Permafrost
964D0653B Moscow MIKROBIOLOGIYA in Russian
Vol 64 No 4, Jul-Aug 95 pp 514-518

[Article by M.B. Vaynshteyn, G.I. Gotova, Kh. Khippe, Biochemistry and Physiology of Microorganisms Institute, Russian Academy of Sciences, Pushchino, and German Microorganism Collection, Braunschweig, Germany; manuscript received 22 Apr 94; UDC 579.844.9]

[FBIS Summary] For the first time, the isolation of sulfate-reducing bacteria from permafrost has been reported. The bacteria were isolated from soil sample No. 343 of the Soil Science and Photosynthesis Institute, which had initially been obtained by drilling into permafrost deposits in an ancient river bed (the bottomland of the Kalyma River) at a depth of 4.2-4.5 meters. The in situ temperature of the sampling site was below -5°C. The deposits were an estimated 20,000 to 30,000 years old, and it was estimated that they had been permanently frozen for at least the past 5,000 to 7,000 years. The sulfate-reducing bacteria was isolated by using a modification of Postgate's "B" medium with lactate supplemented with acetate and butyrate (in a concentration of 1 g/l each). Before the inoculation, the medium had a redox potential of -100 to -200 mV that was achieved by adding dithionite to the medium. A hardened steel wire was placed into each test tube not only to reduce the medium's redox potential but also to serve as a cathodic hydrogen source of the bacteria. The pH of the medium was approximately 7.5. One cubic centimeter of the bacteria-containing soil was cultured per sealed test tube. The pure sulfate-reducing bacteria culture was obtained by repeated multiple dilutions in liquid and dense (agarized) media. The cell's morphology and spore formation were studied by a phase-contrast light microscope. The bacteria's ability to utilize substrates was evaluated in modified Postgate "B" medium. Sulfate reduction was determined by the amount of hydrogen sulfide formed by the bacteria as measured by

the colorimetric method. The biomass used in the pigment analysis was collected after 3-4 days of culturing, resuspended in an NaCl solution, and repeatedly separated by centrifugation. The fatty acids present in the bacterial strain designated 343 were identified, and the strain's fatty acid composition was compared with that of other sulfate-reducing bacteria. The nucleotide sequence of the DNA from the bacterial cells was determined by high-pressure liquid chromatography. The coefficients of linear correlation between 10 standard strains of the genus *Desulfotomaculum* and the newly discovered strain 343 were calculated and presented. Viable sulfate-reducing bacteria were discovered in 10 samples collected from the dark-colored strata of the permanently frozen river bottom soil. The presence of active sulfate-reducing bacteria in the soil samples was confirmed by the fact that while sterilized portions of the sample did not release any hydrogen sulfide, the levels of hydrogen sulfide released by the nonsterilized portions reached 50 mg S/l or more. It was discovered that a temperature of 28°C is optimum for growth of the strain's biomass and for its formation of H₂S. The cultures exhibited good growth at an NaCl concentration of 1.25 percent. No growth occurred in cultures in media with NaCl levels of 2.5 percent or higher. Cytochrome b was present in the bacterial strain's cells. No cytochrome c was present. Analysis of the bacterial strain's fatty acid composition confirmed that it is a member of the genus *Desulfotomaculum*. After its ability to reduce sulfate had been confirmed, strain 343 was deposited in the All-Russian Collection of Microorganisms (VKM) under the number VKM B-2003 and in the German Microorganism Collection (DSM) under the number DSM 8344. Figure 1, tables 3; references 11; 5 Russian, 6 Western.

Russia: Anthropogenic Activation of Bacterial Activity in the Bottom Sediment of Lake Baikal

964D0653C Moscow MIKROBIOLOGIYA in Russian
Vol 64 No 4, Jul-Aug 95 pp 548-552

[Article by B.B. Namsarayev and L.Ye. Dulov, Microbiology Institute, Russian Academy of Sciences, Moscow, and T.I. Zemskaya and M.V. Ivanov, Limnology Institute, Siberian Department, Russian Academy of Sciences, Irkutsk; manuscript received 11 May 93; UDC 579.8.017.7(285.2)]

[FBIS Summary] Anthropogenic activation of the bacterial activity of the bottom sediment of Lake Baikal was studied by collecting and analyzing samples of the lake's bottom sediment at three experimental stations. The first two stations were located in direct proximity to a site where wastewaters are discharged into the lake from the Baikal Paper and Pulp Combine. The water

at station 1 was 24 m deep, and that at station 2 was 28 m deep. Station 3, which was selected as a control station, was located 3-4 km to the side of the wastewater discharge zone. The water depth at station 3 equaled 20 m. The length of the columns of bottom sediment at stations 1, 2, and 3 equaled 6, 10, and 5 cm, respectively. The pH of the three areas ranged from 7.8 to 8.0, and the oxidation-reduction potential at the three stations equaled 415, -75, and 465, respectively. The temperature of the bottom water and surface layers of the bottom sediment at all three sites ranged from 9 to 13.9°C. The number of bacteria present at each station was determined by the method of 10x dilutions, and the rates of the bacterial processes observed were determined by the radioisotope method (incubation of the samples with the radioisotope at the in situ temperatures for 8-24 hours). The concentration of aerobic saprophytes in the water at the three stations ranged from 7,500 to 342,000 cells/ml, with the highest concentration occurring at station 3 and the levels at the other two stations not exceeding 256,000 cells/ml. Two patterns of saprophyte distribution throughout the bottom sediment were found in the study sites: a decrease in the number of saprophytes in the lower layers (station 1) and a peak in the subsurface layers (station 2). The concentration of sulfate-reducing bacteria ranged from 2,500 to 210,000 cells/ml, with the highest concentrations occurring in the surface or subsurface layers of the bottom sediment. The number of sulfate-reducing bacteria in the sandy bottom sediment decreased sharply. The rate of protein degradation at stations 1, 2, and 3 amounted to 7.8, 13.3, and 4.45 mg/kg/d. Between 26.2 and 60.09 mg of cellulose was degraded per kilogram of slime per day, with the maximum rate occurring at station 2 in the layer extending from 4 to 6 cm into the 10-cm column of bottom sediment. In the surface layers of the bottom sediment, cellulose was degraded at a rate of up to 41.13 mg/kg/d. A significant quantity of water-soluble material formed as the cellulose degraded; up to 82.6-99.1 percent of the radioactive marker was found in the said fraction. Between 0.9 and 11.4 percent of the carbon present in the cellulose was broken down to CO₂ per kilogram of slime per day. The sulfate present in the bottom sediment was degraded at a rate of 0.007 to 38.5 µg/kg/d, with the highest rate occurring at station 2 in the layer 1 to 3 cm into the 10-cm column. On the surface layers of the bottom sediment at station 2, sulfate was reduced at a rate of 1.9 µg/kg/d. At the other two stations, sulfate reduction was observed only in the subsurface layers of bottom sediment. The rate of CH₄ formation at stations 1 and 3 ranged from 0.0152 to 0.424 µl/kg/d, whereas in the surface layers of bottom sediment at station 2 it reached 18.87 µl/kg/d. The rates of methane formation from H₂, CO₂, acetate, and

formate were studied by using ¹⁴C-labeled substrates. In the surface layers of bottom sediment, acetate-utilizing methanogens accounted for 50.2-97.7 percent of the CH₄ formed. The rate at which CH₄ was oxidized in the surface layers of bottom sediment amounted to 0.018 µl/kg/d at station 1 and 0.022 µl/kg/d at station 2. Tables 7; references 7 (Russian).

Russia: Degradation of Cellulose in the Bottom Sediment of Lake Baikal

964D0653D Moscow MIKROBIOLOGIYA in Russian
Vol 64 No 4, Jul-Aug 95 pp 553-558

[Article by B.B. Namsarayev and L.Ye. Dulov, Microbiology Institute, Russian Academy of Sciences, Moscow, and T.I. Zemskaya, Limnology Institute, Siberian Department, Russian Academy of Sciences, Irkutsk; manuscript received 4 May 94; UDC 577.152.321:579.8.017.7(285.2)]

[FBIS Summary] Samples of the bottom sediment of Lake Baikal were collected from seven sites throughout the lake in 1991 and 10 sites in 1992. The samples were analyzed (including by the radioisotope method) to identify patterns of degradation of cellulose in the lake's bottom sediment. The samples were collected from a variety of locations, including the near-shore areas of the lake, its deep trenches, the Selenga shallows, the Khakury and Frolikha bays along its shores, and the site where the Baikal Paper and Pulp Combine discharges waste. The near-shore bottom sediment was largely sand or silty sand, while the deep-water bottom sediment consisted of various types of sludge. The pH of the various bottom sediments ranged from 7.2 to 7.8, and the temperature in the upper layers of bottom sediment ranged from 3 to 13°C. It was determined that cellulose enters the bottom sediment of Lake Baikal as the plant life along its shores and phytoplankton decompose. Cellulose also enters the lake from technogenic and river run-off. Finally, a certain amount of cellulose is synthesized by microorganisms. The concentration of cellulose in the various segments of the lake's bottom sediment was found to range from 300 to 2,980 mg/kg, with the highest concentrations occurring in the bottom sediment located along the lake's shores: at sites where decomposed plant matter is concentrated and at those sites where anthropogenic material enters the lake. The highest levels of cellulose were found in the surface and subsurface layers of bottom sediment. The concentration of cellulose decreased significantly between 10 and 20 cm into the column of bottom sediment. The concentration of aerobic cellulolytics present in the samples ranged from 10 to 100,000 cells/ml. The peak levels occurred in subsurface layers of the bottom sediment of Frolikha Bay; 10-20 cm below the sludge's

surface, the concentration of cellulolytics decreased by several orders of magnitude. The cellulose-degrading bacterium *Clostridium* was found to be prevalent in the cultures of samples collected throughout the lake. It was determined that throughout the lake, cellulose decomposed at rates ranging from 0.03 to 60.09 mg/kg/d, with the peak levels occurring at the site where the Baikal Paper and Pulp Combine discharges its sewage. High cellulose decomposition rates (7.0 to 25.6 mg/kg/d) were also found in the bottom sediment from Frolikha Bay. In the shallows near the settlement of B. Koty, the rate of cellulose decomposition was between 14.3 and 14.5 mg/kg/d, and in the shallows near where the Selenga River enters the lake, the process occurred at a rate of 3.9 to 5.1 mg/kg/d. The process of active decomposition of cellulose occurred in the upper 10 cm of bottom sediment, with the highest rates occurring in the surface and immediate subsurface layers. Studies with ¹⁴C-labeled cellulose established that between 0.009 and 2.65 mg C/CO₂ forms each day as a result of degradation of cellulose in the lake's bottom sediments, with 0.70 to 23.18 mg of carbon per kilogram being transformed into a water-soluble form each day. Figures 2, tables 6; references 10: 9 Russian, 1 Western.

Russia: Autonomic Regulator State in Individuals With Autonomic Dystonia Syndrome After Having Been Subjected to Ionizing Radiation as a Result of the Accident at the Chernobyl Nuclear Power Plant
964D0679A. Moscow *ZHURNAL NEVROPATOLOGII I PSIKHIATRII IMENI S.S. KORSAKOVA* in Russian Vol 93 No 4, Jul-Aug 95 pp 32-35

[Article by A.I. Nyaga and R.N. Zazimko, Radiation Medicine Research Center, Ukraine Academy of Medical Sciences, Kiev; manuscript received 24 Dec 91]

[FBIS Summary] The relationship between exposure to ionizing radiation and autonomic regulation of the cardiovascular system was explored in a study of the following groups: (1) 180 men between the ages of 21 and 50 years who had all participated in the cleanup after the accident at the Chernobyl Nuclear Power Plant, had all been diagnosed as suffering from autonomic dystonia, and had all incurred a total (internal and external) dose of ionizing radiation of 0.1 to 1.0 Gy; (2) 15 men who had fought in the war in Afghanistan, had also been diagnosed as suffering from autonomic dystonia syndrome, and had all been subjected to acute and chronic stress but had not been exposed to ionizing radiation; and (3) 20 healthy individuals. The diagnosis of autonomic dystonia in the men in groups 1 and 2 was made on the basis of the following: (1) determination of the difference between the maximum and minimum values of the R-R intervals on their electrocardiograms (ECGs) during slow breathing in a prone position; (2)

calculation of the 30:15 index (ratio of the 30th R-R interval to the 15th R-R interval as an ECG was recorded from the moment of rising during a orthostatic test; (3) performance of the Valsalva test; (4) determination of the changes in systolic arterial pressure in an orthostatic test; and (5) performance of an isometric stress test. The 30:15 test ($P < 0.05$) proved to be the most sensitive and informative test. Overall, the tests measuring heart rate (the first three tests) were found to be the most sensitive for detecting autonomic impairments, both when subjects were at rest and after subjects had been placed under a load. It was concluded, however, that all five tests are required to characterize the autonomic impairments both qualitatively and quantitatively. Neuroregulator dystonia was discovered in 54.5 percent of those studied. The frequencies of the various types of neuroregulator dystonia encountered were as follows: hypertonic, 31.7 percent; hypotonic, 13.4 percent; mixed, 44.3 percent; and cardiac, 10.6 percent. Vegetovascular dystonia was diagnosed in 45.5 percent of those examined, and a permanent-paroxysmal course with different frequencies of crises was noted in 35 percent of the cases. Of the 180 men exposed to ionizing radiation, 73 manifested impaired autonomic regulation of their cardiovascular system while they were at rest, and 101 manifested impaired autonomic regulation of their cardiovascular system after they had performed a test after having been placed under a measured load. Of the cases of neuroregulator dystonia discovered in the men involved in the Chernobyl cleanup, 76.5 were characterized as being of the parasympathetic type, persistent, and difficult to treat. No clear correlation was observed between autonomic disorders and dose of radiation incurred. Of the healthy individuals, only 1 (5 percent) was discovered to be suffering from the beginning stages of impaired autonomic regulation (the parasympathetic type). The contribution of each of the possible pathogenic factors (stress, radiation, other) could not be estimated. Table 1; references 9: 8 Russian, 1 Western.

Russia: Symposium 'Molecular, Cellular and Genetic Mechanisms of Adaptive Behavior'
964D0735A. St. Petersburg *FIZIOLOGICHESKIY ZHURNAL SSSR IMENI I. M. SECHENOVA* in Russian Aug 95 Vol 81 No 8, pp 1-2

[Unattributed article; UDC 612.006.3+612.014.1]

[FBIS Translated Text] The symposium "Molecular, Cellular and Genetic Mechanisms of Adaptive Behavior" was conducted in St. Petersburg at the Institute of Physiology imeni I. P. Pavlov of the Russian Academy of Sciences on 20-23 December 1994 in accordance with decisions of the Physiology Division of the Russian Academy of Sciences and the Russian Academy of Sciences Scientific Council for Physiological Sciences.

The main objective of the symposium was to discuss new data pertaining to molecular, genetic and neuro-

physiological mechanisms of various forms of adaptive behavior with the goal of uniting the efforts of specialists in different fields of neurobiology, and developing a strategy of integrated research on this important and complex problem. One plenary and four section meetings and a roundtable discussion were held. Survey reports on the main directions of the problem under consideration were presented at the plenary meeting.

Neurophysiological and neurochemical correlates of cognitive processes were discussed in the first section meeting. The role of different microsystems of cerebral neurons and neuromediator systems in the mechanisms of learning and memory were examined. It should be emphasized that a significant part of the experimental material that was presented was obtained in research on monkeys using an integrated organizational approach. The value of the papers presented in this section lies in the fact that they reveal the mechanism of interneuron signal transduction, which is implicated in formation of complex forms of adaptive behavior.

The second section meeting was devoted to a discussion of neuro-endocrine mechanisms of formation of adaptive behavior. The discussion on this issue showed that this research, which has recently been conducted intensively abroad, is successfully developing in our country as well. The same can also be said for the study of the genetic aspect of adaptive behavior, which was considered in the third section meeting. In this direction Russian scientists hold the lead in research on genetic control of intracellular regulatory systems and their influence on the genome.

The fourth section meeting was devoted to issues pertaining to the role of synaptic and intracellular signal transduction in formation and realization of different types of adaptive reactions of the central nervous system. Special attention was turned to a new, promising research direction—implication of intracellular regulatory systems, the genome and endogenic neuromodulatory factors in the mechanism of development of elementary forms of learning (sensitization, classical conditioning, post-tetanic potentiation) based on relatively simple experimental models (the invertebrate nervous system, mammals surviving brain sectioning). On the last day of the symposium, general discussion regarding the prospects and complexities of multilevel analysis of adaptive behavior was conducted at a roundtable meeting, and the resolution of the symposium participants was adopted.

Russia: Localizing Sites of the Development of Anomalous Miniature End-Plate Currents in a Neuromuscular Synapse

964D0658A Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Sep 95 Vol 120 No 9, pp 235-238

[Article by A.L. Zefirov and S.Yu. Cheranov, Normal Physiology Department (head, Professor A.L. Zefirov), Kazan State Medical Institute; manuscript received 12 Apr 94]

[FBIS Summary] The sites of occurrence of anomalous miniature end-plate currents (MEPCs) in the neuromuscular synapse were localized in experiments performed on neuromuscular preparations of the sternocutaneous muscle of the frog *Rana ridibunda*. After the preparation had been isolated, it was placed in a 7-ml glass tray and continuously superfused with Ringer's solution for cold-blooded animals. The solution, which had a temperature of 20°C, contained the following (mmol/l): NaCl, 118.0; KCl, 5.0; CaCl₂, 0.3; MgCl₂, 2.0; and NaHCO₃, 2.4. A Biorad polarization-interference microscope (magnification, 400x) was used to visualize the surface nerve endings and connect microelectrodes to them. The microelectrodes were filled with NaCl (2 mmol/l) and had an inner tip diameter of 1-3 µm. The synaptic signals (400-600 MEPC and/or 200-400 end-plate currents) were recorded with one or three extracellular electrodes. The signals were amplified and measured automatically by using an IBM PC. The coordinates of the points where mediator was released were determined, and graphs of the secretion of mediator into the nerve endings were plotted by comparing the nature of the distribution of the sites of occurrence of o-MEPC and a-MEPC. In some experiments, 4-aminquinolinic acid (0.25 mmol/l) and emetine (10 mmol/l) were added to the perfused solution to increase the frequency of a-MEPC. The experiments were also performed on frogs that had been deservated, in which case their MEPCs were recorded on day 4 after the deservation procedure. Motor nerve stimulation was accomplished by using rectangular electric pulses with an above-threshold amplitude and duration of 0.15 to 0.3 ms. Deservation and addition of 4-aminquinolinic acid and emetine to the perfused solution resulted in an increase in the frequency of the signals recorded. Examination of the topography of the sites of occurrence of signals in the nerve ending by the three-microelectrode method demonstrated that quanta of mediator responsible for the generation of postsynaptic signals are released not in the active zones but rather in limited segments of synapse located between the terminal sections of the active zones. It was concluded that the source of the quanta of mediator responsible for generation of postsynaptic signals is the Schwann cell, which is char-

acterized by a mechanism of mediator release that is very different from the mechanism of mediator release from a nerve ending. Figures 3; references 11: 4 Russian, 7 Western.

Russia: Effect of Pro-Oxidants on Survival of Experimental Animals and on the Luminescence of Whole Blood Cells Under Conditions of the Effect of the Toxic Shock Endotoxin *Staphylococcus aureus* in Vivo

964D0658B Moscow BYULLETEN

EKSPERIMENTALNOY BIOLOGII I MEDITSINY

in Russian Sep 95 Vol 120 No 9, pp 258-259

[Article by A.P. Shepelev, A.Yu. Antipov, and V.M. Polyakov, Biopreparat Scientific Production Association, Rostov-na-Donu; manuscript received 31 Oct 94]

[FBIS Summary] A study examined the effect of pro-oxidants on the survival of chinchilla rabbits and on the luminescence of whole blood cells exposed to the toxic shock endotoxin *Staphylococcus aureus*. The animals were divided into five groups of eight rabbits each. One group served as intact controls. All rabbits in the remaining four groups were administered the median lethal dose of toxic shock endotoxin. The controls received only the toxic shock endotoxin. The experimental animals were divided into three groups and received intraperitoneal injections of the following: adriablastin (in a dose of 1 mg/kg body weight); catalase (40,000 units/kg body weight); and tocopherol (1 mg/kg body weight). Polymorphonuclear leukocyte activity was estimated by the chemiluminescence method. Lethality in the experimental animals and controls was determined 24, 48, and 72 hours and 7 days after administration of the toxin. The results were analyzed by the generally accepted statistical analysis methods. The pro-oxidant adriablastin prolonged survival significantly, whereas the antioxidants (catalase and tocopherol) had no significant effect on rate of survival. As of day 7 of the experiment, six of the control rabbits had died as had six of the rabbits that received the tocopherol and five of the rabbits that had received the catalase. Of the eight rabbits administered the adriablastin, however, seven remained alive. Both 45 minutes and 180 minutes after the control rabbits had received toxic shock endotoxin, the spontaneous chemiluminescence of their blood cells (5.86 ± 1.81 and 5.98 ± 1.02 relative units, respectively) was significantly lower than that of the intact controls (13.34 ± 2.42 relative units). The opsonized zymosan-stimulated chemiluminescence of the blood cells of the animals administered the toxic shock endotoxin (5.47 ± 1.12 , 7.96 ± 1.02 , and 1.73 ± 0.82 relative units as of 45, 180, and 360 minutes after administration of the endotoxin) was also significantly lower than that of the

intact controls (16.65 ± 2.02 relative units). In contrast, the spontaneous chemiluminescence of the rabbits administered both toxic shock endotoxin and adriablastin equaled 40.12 ± 3.39 , 28.14 ± 5.23 , and 26.73 ± 2.08 relative units 45, 180, and 360 minutes after administration of the endotoxin. Although the levels of opsonized zymosan-stimulated chemiluminescence of the animals receiving the adriablastin remained significantly below the levels of the intact controls throughout the course of the experiment (3.08 ± 0.48 , 3.66 ± 0.91 , and 4.76 ± 0.84 relative units as of 45, 180, and 360 minutes after administration of the toxic shock endotoxin), they did not appear to be decreasing significantly as of 6 hours into the experiment. It was concluded that the pro-oxidant adriablastin helps reduce the lethal effects of toxic shock endotoxin, which may be due to activation of the generation of active forms of oxygen by the blood's phagocytes. Tables 2; references 7: 2 Russian, 5 Western.

Russia: Effect of Basic Fibroblast Growth Factor on the Development of Parkinsonian Syndrome in Mice

964D0658C Moscow BYULLETEN

EKSPERIMENTALNOY BIOLOGII I MEDITSINY

in Russian Sep 95 Vol 120 No 9, pp 260-262

[Article by G.N. Kryzhanovskiy, V.G. Kucheryan, Ye.V. Nikushkin, and N.A. Krupina, General Nervous System Pathology Laboratory (head, G.N. Kryzhanovskiy, academician, Russian Academy of Medical Sciences), General Pathology and Pathophysiology Scientific Research Institute, Moscow; manuscript received 19 Sep 94]

[FBIS Summary] The effect of basic fibroblast growth factor on the development of Parkinsonian syndrome was studied in 7-month-old male mice of the line C57Bl/6. Parkinsonian syndrome was induced in the mice by systemic intraperitoneal injection of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) in a dose of 20 mg/kg twice daily for 10 days at 12-hour intervals. The animals were also given basic fibroblast growth factor before and after days 3 and 5 after initiation of the MPTP injections. Basic fibroblast growth factor was administered bilaterally into the nasal cavity of each mouse in a dose of 3 μ g. To increase its activity, basic fibroblast growth factor was treated with heparin in a concentration of 1 μ g heparin to 1 ml of basic fibroblast growth factor solution. The mice in the control group received a physiologic solution in the same volume and under the same conditions. Development of Parkinsonian syndrome was judged on the basis of degree of oligokinesia and muscular rigidity. Motor activity was evaluated on days 1, 3, 5, 7, and 10 after initiation of the MPTP injections and was expressed as a

percentage in relation to the motor activity of the control animals. Rigidity was expressed on a point scale. The effects of MPTP on body weight and survival were also examined. Within 3 days of first receiving MPTP, the animals that received MPTP but no fibroblast growth factor began to exhibit decreased overall motor activity and decreased numbers of "large" movements, with the maximum decreases being noted on days 5-7 after initiation of the MPTP injections and persisting until day 10. The animals that received both MPTP and fibroblast growth factor exhibited only a slight decrease in overall motor activity and number of "large" movements on day 5 after initiation of the MPTP injections. By days 7 and 10, however, their levels of overall motor activity and "large" movements were practically the same as those of the control animals. Intranasally administered fibroblast growth factor was found to attenuate the development of oligokinesia, muscular rigidity, and weight loss and reduce the death rate in mice in which Parkinsonian syndrome had been induced by MPTP. Muscular rigidity developed in 87 percent of the mice that received just MPTP but only developed in 25 percent of the mice receiving both MPTP and fibroblast growth factor. The muscular rigidity of the mice receiving just MPTP was rated as 1.75 points on day 5 and 2 points on day 10 after initiation of the MPTP injections, whereas the muscular rigidity of the mice receiving both MPTP and fibroblast growth factor was rated as 0.25 points. Over the 10-day course of MPTP injections, the average weight of the mice receiving just MPTP decreased from 29.7 ± 0.9 g to 23.6 ± 1.4 g, whereas the mice given both MPTP and fibroblast growth factor did not experience any noticeable weight loss. Fifty percent of the mice receiving just MPTP died, whereas none of the mice receiving MPTP plus fibroblast growth factor and none of the controls died. Figures 2; references 13: 1 Russian, 12 Western.

Russia: Biomedical Criteria for Categories of Particularly Dangerous Chemical Rail Freight
964D0124A Moscow GIGIYENA I SANITARIYA
in Russian No 5, Sep-Oct 95 pp 11-15

[Article by A.G. Bazazyai and S.V. Suvorov, Ministry of Railroads Research Institute of Hygiene, Moscow; (manuscript received 2 Feb 93) UDC 613.632:656.2-07]

[FBIS Translated Text] Railroad science, including railroad medicine, makes a distinction between several types of acute hazard manifested in emergency situations: explosion, fire, radiation, infection, and toxicity. Other types of hazard are also taken into consideration — for example, marked corrosive and caustic properties.

The preventive medical aspects of transporting hazardous chemical freight (HCF) and of cleaning up accidents with it on railroads are reflected rather fully in the literature of recent years [6, 10, 15, 21]. The current list of HCF carried in closed rail cars in bulk, in compressed and in liquefied states contains more than 100 names. HCF is represented in many classes of current complex classifications of freight listed in GOST (All-Union State Standard) 19433-88: "Freight, hazardous: Classification and labeling".

The purpose of our study was to validate criteria for singling out chemical freight that belongs in the class of particularly hazardous chemical freight (PHCF).

Analysis of domestic and international documents in force — data in the literature and reference materials on transportation of hazardous freight — convinced us that information given there concerning particularly hazardous freight is rather limited and lacks appropriate scientific validation. Thus, in one of the reference publications [1], the list of particularly hazardous freight includes some potent toxic substances (PTS) — such as yellow phosphorus, arsenic, and liquid ethyl — which are extremely and highly toxic and hazardous substances but do not cause mass injuries in case of accident. The rules for transporting graded freight [2, 17] use the term "most hazardous freight," referring to PTS, explosive substances and ammunition. Carrying such freight by rail requires special precautionary measures. However, the rules do not deal with the concept of "most hazardous freight" and criteria for defining it. In Germany, there is a special government decree defining lists of hazardous freight, the hauling of which by motor vehicles is limited or effected only under special conditions, depending on the weight of the freight. The guidelines for classifying hazardous substances are not given [26]. The main documents in our country dealing with transportation of hazardous freight (GOST 19433-88), which is based on international recommendations [20], furnishes specific indicators and criteria of extent of hazard (high, moderate and low) for different classes of toxic freight. However, one must take into consideration the substantial differences between criteria for evaluating the parameters of toxicity and hazard of substances adopted in our country [22] and abroad [20].

There are interesting differentiated criteria for identification of hazardous and particularly hazardous substances (freight) in the new rules of fire safety PPB-01-93 [18]. But these data can apply only in part to the conditions of transporting freight, as they deal with fire safety requirements when substances and materials are stored together (at warehouses and bases), based on their caustic and/or corrosive properties.

As can be seen, a need for criteria of particular hazard of transported chemical freight is evident in several extremely important regulatory documents, but there is no clarity, let alone uniformity in this matter.

To solve the problem, it is necessary first of all to define the concept of PHCF. By way of discussion we propose the following formulation: One should classify as PHCF substances and materials with properties that could cause mass injury to people or large-scale harm to the environment. This concept is an extension of the broader concept of particularly hazardous freight that we developed with V.N. Androsyuk, E.S. Freyman, V.M. Rudanovskii, and others [12], which deals with not only chemical but also explosive and inflammable freight. In this article we shall discuss only PHCF.

It is known that the vast majority of transported chemical compounds present the danger of acute and chronic poisoning if safe transportation conditions are not maintained or in case of accident. However, only a small part of the substances with some combination of toxic and physicochemical properties can lead to group and mass poisoning in case of accident. In civil defense, the term "potent toxic substances" (PTS) is used for such substances [2]. Unfortunately, there are still no clear-cut criteria for classifying substances as PTS, whereas the very concept of "potent toxic substances" is still the subject of scientific discussion. For example, the formulation contained in GOST 22.0.002-86 "Terms and definitions" raises criticism: "PTS are chemicals used in the national economy that could lead to contamination of the air in harmful concentrations or doses if spilled or discharged." This too-broad concept does not focus on the extent and severity of consequences of accidents with such substances.

The number of most hazardous substances identified as such varies in different countries, and it requires serious comparisons which, however, is beyond the scope of this article. We merely submit basic information on this score. The list prepared by the UN Environmental Protection Agency (EPA) of chemicals of greatest hazard to man if they penetrate into the environment comprises 308 names [7]. The list of most hazardous substances approved by the International Labor Organization with the participation of UNEP and the WHO comprises 180 substances [13]. Our "Temporary List of PTS" in effect up to 199 had 107 names. However, along with substances presenting the hazard of mass injury, these lists contain a number of substances that would not present a real danger of such consequences even in case of major spills. Evidently, it is because of these circumstances that the Russian list of PTS has been reduced to 34 items [3, 14]. Of course, the potential toxicity of substances in the extremely and highly hazardous classes

is of deciding importance in assessing the effect on an individual in case of direct contact with a substance. As for the real hazard of mass poisoning, it depends on a number of additional conditions (weight of the substance, physicochemical properties, meteorological and landscape conditions).

Analysis of consequences of various accidents with PTS and experience gained in assessing the ensuing chemical situation [4, 7, 25] confirm the validity of the thesis that the range of particularly hazardous substances must be limited by three main criteria:

- extreme and high toxicity of substance (freight);
- volatility, i.e., capacity to readily pass into the atmosphere in the form of vapor (gas) and fine aerosol in case of accident;
- presence in industrial facilities and transport of substances in a volume (mass) exceeding safety standards and potentially causing mass injury to people.

From this point of view, we can consider the definitions of the PTS concept contained in the latest publications [5, 25] to be more acceptable. Unlike prior definitions, they take into consideration in part the above-mentioned factors and, mainly, emphasize the possibility of serious consequences in case of accident (mass poisoning or death of people and animals).

Long ago, preventive toxicology defined well the hazard of volatile toxic substances using the coefficient of possible acute inhalation poisoning (CPIP, according to I.V. Sanotskiy). According to GOST (SSBT) 2.1.007-76 "Toxic substances. Classification and general safety requirements," extremely hazardous substances are those with CPIP over 300, and highly toxic ones — with a coefficient of 30-300. Substances in the last list of PTS [3, 14] meet this description.

In our opinion CPIP is in general the most important criteria for identifying PHCF among hazardous freight. The need for such a rating of HCF was perceived even up to 1990 when the PTS list comprised 107 substances. Now that it has been reduced to 34, it is growing extremely important to single out the PHCF among the numerous types of HCF being transported.

While we attribute proper significance to CPIP in screening PHCF, it should be noted that this indicator does not take into consideration some of the above-discussed aspects of the real hazard of chemicals (freight). For this reason, in addition to the CPIP, we used an adequate indicator of the real accidental hazard to man, such as depth of contamination zone which is indicative of the possible scale of spread of chemicals in harmful toxic doses if they are discharged

(spilled) into the environment. There are data in the literature concerning PTS, indicating that there is a direct relationship between size of contaminated zone and value of CPIP [4].

Nominal sizes of contamination zones were defined for PHCF with consideration of data in the literature and official reference sources dealing with evaluation of chemical accident situations, including railroad accidents [8, 9, 19].

In our opinion, extremely and highly toxic volatile substances that form, in case of accidental discharge (spill) a zone of contamination with harmful concentration beyond the limits of the railroad cars thus presenting a threat to the life of people around them can present an increased hazard. For PHCF, we adopted the size of such a zone for two variants of an accident situation: accidents related solely to discharge or spill of substances (without fire) — more than 500 m from the source; accidents accompanied by fire and simultaneous discharge (spill) of substances — more than 800 m from source, i.e., in both instances consideration is given to exceeding the conventional hazardous accident zone.

Consequently, we consider the increased hazard of acute fatal inhalation poisoning, the quantitative expression of which is CPIP (30 or more) combined with larger contamination zone as a result of accidental discharge or spill of HCF (more than 500-800 m) to be the chief criteria for classifying chemical freight as PHCF. More precisely, HCF of various classes that has both adverse indicators must be classified as PHCF.

In addition, to assess the hazard of some chemical freight we proposed one more criterion that is applicable for a relatively small group of highly toxic substances with moderate volatility (such as bicyclopophosphates, heptyl, tricresyl phosphate, sodium fluoroacetate, chlorobenzene and several others). Even in the case of brief exposure to such substances, victims can expect severe and prolonged poisoning that responds poorly to treatment. In addition, such substances are highly stable at the site (evaporation takes more than 24 h), which augments appreciable the risk of injury. For this reason it is quite justified to classify such substances as PHCF, despite the fact that they do not meet the above criteria of inhalation hazard.

As for such an extremely important indicator of particular hazard as freight weight, it is always important for HCF since transportation of the vast majority of such freight is effected in carloads, when the weight of a substance is usually in the tens of tons and, in case of accident, there is a rather high probability of poisoning of railroad personnel.

In the course of these studies, with consideration of the above criteria, we carried out analytical and mathematical testing of hazard for all currently transported volatile chemical large-size freight.¹

As baseline data we used the collections in official effect of rules for transportation and railroad rates which contain a complete list of hazardous freight known to date which are allowed to be carried by rail in open cars, containers, tanks and gondola hopper cars [13, 16, 23, 24]. We calculated CPIP and maximum contamination zone for all toxic substances that are an inhalation hazard. Special attention was given to freight in the relevant subclasses of Class 2 of "freight hazard" (toxic gases, toxic and inflammable gases), Class 3 (inflammable liquids), Class 6 (toxic substances) and Class 8 (caustic and/or corrosive substances) according to GOST 19433-88 "Freight, hazardous. Classification and labeling."

We used the conventional formula to calculate CPIP:

$$\text{CPIP} = C_M^{20} / \text{CL}_{50}$$

where the first term on the right side of the equation refers to maximum concentration of substance fumes in air at 20°C temperature, mg/l; $\text{CL}_{50}/4$ is median lethal concentration of given substances established in albino mice after 2-h exposure, mg/l.

Calculations of maximum depth of involved zone were carried out using methods in effect at the present time [11], with consideration of certain standard conditions: total destruction of standard container (50 tons), worst meteorological conditions (inversion, wind velocity 1 m/s, air temperature 20°C).

On the basis of calculations of the entire array of chemical freight examined (about 450 names), we singled out a group of 43 substances that had a high probability of causing acute fatal inhalation poisoning (CPIP 30 or more) and forming considerable contamination zones (more than 500-800 m) in case of accident, which we classified as PHCF. In turn, we divided these substances into two classes according to degree of danger of acute inhalation poisoning: 1 — extremely hazardous (CPIP >300) and 2 — highly hazardous (CPIP from 300 to 30). This classification and list of PHCF with high inhalation hazard carried by rail are listed in Table 1.

Table 1. Classification and list of particularly hazardous chemical freight (PHCF) with high danger of inhalation during transportation

No	Name of substance
Class 1. Extreme danger of acute inhalation poisoning	
1	sulfurous anhydride (sulfur dioxide)
2	Inhibited acrolein
3	Acetone cyanohydrin
4	Anhydrous hydrogen fluoride
5	Anhydrous hydrogen chloride
6	Anhydrous dimethylamine
7	Nitric acid, concentrated solution (ca)
8	Hydrogen bromide, ca
9	sulfuric acid, ca
10	prussic acid (hydrocyanic acid)
11	Hydrochloric acid, ca
12	hydrofluoric acid, ca
13	3/Bromous methyl (methyl bromide)
14	Chlorous methyl (methyl chloride)
15	Anhydrous monomethylamine (anhydrous methylamine)
16	Acrylic acid nitrile (acrylonitrile)
17	Liquefied hydrogen sulfide
18	Mixture of hydrochloric and hydrofluoric acids
19	formaldehyde (ca)
20	Phosgene
21	Trichlorophosphorus (phosphorus trichloride)
22	Phosphorus hydroxychloride
23	Chlorine
24	Chloropicrin
25	Stabilized cyanogen chloride
26	Oxide of ethylene (ethylene oxide)
Class 2. High danger of acute inhalation poisoning	
27	Anhydrous ammonia
28	Acetonitrile
29	Benzotrichloride
30	Diethylamine
31	Inhibited methylacrylate
32	Methylvinyl dichlorosilane

No	Name of substance
33	Methyl dichlorosulfane
34	Methyl trichlorosulfane
35	Methyl dichloromethyl dichlorosulfane
36	Methyl chlorosulfane
37	SPM odorant
38	carbon disulfide
39	Anhydrous trimethylamine
40	Triethylamine
41	Chloroform
42	Ethylenediamine
43	Ethylmercaptan

This list gives the official names of substances as previously established, as well as altered (in parentheses) ones in accordance with collections of rules in effect for freightage and rates [23, 24].

As can be seen, most of the substances on this list are present in the most recent official list of PTS [3]. However, there are also some differences. In particular, our list does not include six conventional PTS names which are not being transported in the form of large volume freight (methylmercaptan, arsenic hydride, nitric oxides, fluorine, ethylenimine, ethylenesulfyl). At the same time the PHCF list has 15 additional entries not contained in the PTS list, but which according to estimates present a substantial inhalation hazard and should be classified as PHCF and PTS (diethylamine, benzotrithloride, concentrated nitric, sulfuric and hydrofluoric acids, SPM odorant, mixture of hydrochloric and prussic acids, triethylamine, five chlorosilane compounds, chloroform and ethylenediamine). In other words, the official PTS list is not sufficient to organize preventive medical work with HCF that causes mass poisoning.

Along with defining the list of PHCF, which by virtue of their high toxicity and volatility definitely present the greatest danger of mass inhalation poisoning in case of railroad disasters, we singled out an additional group of potentially hazardous substances that are on the list of products that are transported. They include moderately volatile chemicals (CPIP <30) that could present a danger of poisoning with serious consequences due to the aggregate of their toxic properties (Table 2).

Table 2. List of moderately volatile toxic substances presenting a danger of poisoning with serious consequences (CPIP <30) in case of accident during transportation

No	Name of substance
1	Acetic anhydride
2	Aniline
3	Acetic aldehyde (acetaldehyde)
4	Hydrogen peroxide (over 50 percent concentration)
5	Chlorous benzyl (benzyl chloride)
6	Bromine
7	Inhibited vinyl acetate
8	Vinyl trichlorosulfane

No	Name of substance
9	Heptyl ^a
10	Hydrazine (hydrazine or sulfaz) ^a
11	Dibutene, inhibited
12	Dimethylamine
13	Dimethyldichloroamine
14	Dimethylformaldehyde
15	Dimethylamine
16	Dimethylchloromethylchloroamine
17	Diethylamine
18	Glycerin dichlorohydrin
19	Dichlorodibenzene
20	Diethylchloroamine
21	Isomylene
22	Isopropylamine
23	Formic acid
24	Perchloric acid
25	Chlorosulfonic acid
26	Methyl acetate
27	Methyl alcohol
28	Chloro
29	Amyl peroxide
30	Mercury ^a
31	Mercury dichloride ^a
32	Mercury cyanide
33	Mercury cyanide ^a
34	Tetraammonium
35	Nickel tetracarbonyl ^a
36	Tetraammonium
37	Tetraammonium
38	Tetrachloroethane
39	Tetrachloroethane
40	Tetrachloroethane
41	Tetrachloroethylene
42	Trichloroethylene
43	1,2,3-Trichloropropane
44	Trichloroethylene

No	Name of substance
45	Tris(hydroxymethyl)aminomethane
46	Tetrachloroethene (carbon tetrachloride)
47	Tetrachloroethane (carbon tetrachloride)
48	Phenylhydrazine
49	Chlorobenzene*
50	Epichlorohydrin
51	Ethyl dichloromethane
52	Ethyl trichloromethane
53	Ethyl chloromethane

Note: Asterisks indicate that product was classified as PHCF according to one of proposed criteria.

It is important to stress that most of the substances listed in Table 2 were on the PTS list in effect previously (107 entries) and for this reason alone require more attention. Distinction of an additional group of substances is due to the fact that the CPIP criterion does not cover all aspects of toxicity and hazard of chemical compounds that were apparently taken into consideration when preparing the previous fuller list of PTS. Among the substances listed in Table 2 we found several compounds that elicit severe and prolonged poisoning that responds poorly to treatment, and which are characterized by on-site stability. Substances meeting these two criteria (hydrazine, heptyl, nickel tetracarbonyl, mercury and compounds thereof, chlorobenzene) can be added to the PHCF category. In view of the foregoing, the substances listed in Table 2 must not be overlooked in the next amendment of the list of particularly hazardous freight, as well as in assuring safety of the shipping process and protection of the public in case of accident.

Conclusions

1. The list of particularly hazardous chemical freight (PHCF) carried by rail, as well as criteria for classifying chemical freight in this category have been validated. This list comprises substances with high inhalation hazard, and it includes 15 new particularly hazardous chemicals in addition to conventional PTS (total 43 entries).
2. The additional (second) list comprises mainly substances (freight) which do not meet the proposed criteria but require special attention by virtue of their marked toxic properties. Several of them (eight) present the danger of poisoning with serious consequences to people and the environment, which allows us to place them in the PHCF category.

3. PHCF cannot be opposed to other chemically hazardous freight. Both require strict adherence to existing norms and rules for railroads. However, with respect to PHCF additional steps are necessary to prevent accidents and, first of all, organization of a system of constant control while in transit via railroads in Russia.

Footnotes

1. S.N. Korzunov, senior scientific associate, participated in the calculations.

References

1. Avezityan, M. A., and Fefelov, A.M., "Spravochnik rabotnika tekhnicheskoy kontory" [Manual for Engineering Office Workers], Moscow, 1982.
2. "Interim List of Potent Toxic Substances for Use in Organizing Protection of Blue- and White-Collar Workers and the Public Against Them" "Direktiva nachalnika GOSSSR" [Directive of USSR Civil Defense Chief], No 7, Moscow, 1987.
3. "Interim List of Potent Toxic Substances," Ibid, No 3, Moscow, 1990.
4. Izayev, V. S., Korzunov, S. N., Lepikorshev, Ye. P., et al., "Problemy bezopasnosti pri chrezvychaynykh situatsiyakh" [Safety Problems in Emergency Situations], Moscow, 1991, No 10, pp 46-47.
5. "Katalog osnovnykh ponyatiy Rossiyskoy sistemy preduprezhdeniya i deystviy v chrezvychaynykh situatsiyakh" [Catalogue of Main Concepts in the Russian System of Preventive Measures and Action in Emergency Situations], All-Russian Research Institute of Emergency Situations in Civil Defense, Moscow, 1993, p 14.

6. Krivulya, S.D., Korshunov, Yu.N., Suvorov, S.V., and Shterengari, R.Ya., "Gigiyena na zheleznodorozhnom transporte" [Railroad Hygiene], Moscow, 1992.
 7. Livanov, G. A., Mikhaleva, A. L., and Ramsh, S. M., ZHURN. VSESOYUZ. KHIM. O-VA IM. D. I. MENDELEYEVA, 1990, Vol 35, No 4, pp 447-452.
 8. Marshall, V., "Osnovnyye opasnosti khimicheskikh proizvodstv" [Main Hazards of Chemical Production], Moscow, 1989.
 9. "Materialy analiza toksikologicheskoy obstanovki ... po RF za period 1985-1992 gg." Data on Analysis of Toxicological Situations ... in the Russian Federation in the 1985-1992 Period," (GKChS ROSSII, No 403/17 dated 26 Feb 93), Moscow, 1993.
 10. Korshunov, Yu. N., and Suvorov, S. V., eds., "Meditsinskiye voprosy likvidatsii posledstviy avari na zheleznodorozhnom transporte" [Medical Aspects of Eradicating Consequences of Railroad Accidents], Vol 1-3, Moscow, 1991.
 11. "Metodika prognozirovaniya masshtabov zarazheniya SDYaV pri avariakh (razrusheniyakh) na khimicheski opasnykh ob'yektakh i na transpote" [Methods of Predicting Extent of PTS Contamination in Case of Accident (Demolition) With Hazardous Chemicals and During Transportation Thereof], Moscow, 1990.
 12. "Sovershenstvovaniye i rasshireniye primeneniya sistemy slezheniya za perevozkami OOG" [Refinement and Expansion of Use of System for Tracking Particularly Hazardous Freight], Report on research at All-Russian Railroad Research Institute of Railroads Ministry, Vol 2, Moscow, 1994.
 13. "List of Hazardous Substances," International Labor Organization, Geneva, 1988.
 14. "Perechen opasnykh khimicheskikh produktov, pri nakhozhenii kotorykh na proizvodstve, libo na khraneni vyshch ustanovlennyykh ob'yemov neobkhodima razrabotka dopolnitelnykh meropriyatiy po zashchite naseleniya na sluchay avarii s etimi produktami" [List of Hazardous Chemicals Presence of Which at Production Site or in Storage in Amounts Exceeding Established Limits Requires Additional Steps to Protect the Public in Case of Accident With Such Products], (Approved by USSR Civil Defense headquarters chief on 20 Dec 1990), Moscow, 1990.
 15. "Pravila bezopasnosti i poryadok likvidatsii avariynykh situatsiy s opasnymi gruzami pri perevozke ikh po zheleznym dorogam" [Safety Rules and Procedure for Cleaning Up Accidents With Hazardous Freight Carried by Rail], Moscow, 1984.
 16. "Pravila perevozok opasnykh gruzov (Razdel 42 Pravil perevozok gruzov — Ch. 2)" [Rules for Carrying Hazardous Freight (Section 42 of Rules for Carrying Freight — Pt 2)], Moscow, 1987.
 17. "Pravila perevozki razryadnykh gruzov" [Rules for Carrying Classified Freight], Moscow, 1980.
 18. "Pravila pozharnoy bezopasnosti v Rossii (PPB-01.93)" [Fire Safety Rules in Russia], Moscow, 1994, pp 72-88.
 19. "Profilakticheskiye mery pri perevozkakh opasnykh gruzov na zheleznodorozhnom transporte" [Preventive Measures When Carrying Hazardous Freight by Rail], Moscow, 1995.
 20. "Recommendations for Transporting Hazardous Freight," UN, 6th ed., New York, 1987.
 21. Krivulya, S. D., Korshunov, Yu. N., and Suvorov, S. V., eds., "Rukovodstvo po mediko-profilakticheskim aspektam raboty s opasnymi gruzami na zheleznodorozhnom transporte" [Manual on Preventive Medical Aspects of Working With Hazardous Freight Carried by Rail], Moscow, 1991.
 22. Sanotskiy I. V., and Ulanova, I. P., "Kriterii vrednosti v gigiyene i toksikologii pri otsenke opasnosti khimicheskikh soyedineniy" "Hygienic and Toxicological Criteria of Harmfulness in Assessing the Hazard of Chemical Compounds], Moscow, 1975, pp 74-93.
 23. "Sbornik pravil perevozok i tarifov zheleznodorozhnogo transporta" [Collection of Rules for Rail Freightage and Rates], No 370, Moscow, 1990.
 24. Ibid, No 392, Moscow, 1992.
 25. "Silnodeystviyushchiye yadovityye veshchestva i zashchita ot nikh" [Potent Toxic Substances and Protection Against Them], Moscow, 1989, pp 5-8.
 26. Appendix B to Road Safety Regulations (GGVS) (in ADR) [in German], Berlin, 1990.
- Summary: Problems of Railroad Radiation Hygiene**
964DO124B Moscow GIGIYENA I SANITARIYA
in Russian No 5, Sep-Oct 95 pp 40-42
- [Article by E.S. Freyman, Ministry of Railroads All-Russian Railroad Hygiene Research Institute, Moscow; manuscript received 24 Feb 95; UDC: 613.648:656.2]-07]
- [FBIS Translated Text] Railroad radiohygiene research has been carried out since 1959 when a radiology laboratory was opened at the RHI [All-Union Railroad Hygiene Research Institute] (renamed as the radiation hygiene laboratory in 1973), which had the purpose

of becoming this sector's research and methodology center. Railroad radiation hygiene developed under the determinative influence of general principles of Russian science expounded by the work of F. G. Krotkov, A. A. Letavet, L. A. Ilyin, P. V. Ramzayev, A. P. Tryb, A. I. Burnaryan, N. Yu. Tarasenko, Ye. F. Cherkasov, A. K. Quakova, L. A. Buldakov, V. Ya. Golikov, Yu. G. Grigoryev and many others.

Research on radiation hygiene at the RHI has covered a broad range of problems in the last decades that are important to this sector and to public health in the nation as a whole. They include: hygiene and safety of radioactive freightage, including nuclear materials; clean-up of railroads after the Chernobyl, Ural and other disasters and accidents; hygienic assessment of conditions for using specific sources of ionizing radiation on railroads; radiohygiene aspects of civil defense on railroads; radiobiological research with simulation of irradiation of railroad workers; elaboration of preventive measures in constructing railroads in the presence of a high radiation background; amendment of legal bases and the system of sanitary oversight in the area of radiation hygiene on the network of the nation's railroads.

The study of the above matters was carried out mainly with use of series produced equipment and standard methods. For the sake of convenience of working on expeditions, train stations and during runs, special laboratory cars were developed and used extensively.

Railroad shipment of radioactive substances has been particularly important since the 1950s-1960s because of the nuclear arms race, the program for building and operating nuclear power plants and other installations involving a nuclear fuel cycle, development of atomic fleets, atomic reactors used for research and training, extensive use of isotope technology and radionuclides. There is large-scale transportation by rail of radioactive ore and concentrate, products of nuclear chemical and metallurgic industries, radioactive products for science and medicine, gamma flaw detectors, level gauges and other isotope equipment. Mainly long-lived nuclides, with high activity that exceeds 4×10^{14} Bq in some cases per container are carried by rail. The geography of deliveries is quite vast. Trains with radioactive freight travel over lines of the northern, central and southern European part of the country, the Urals, Siberia, and Far East. There is international freightage of radioactive products in considerable volume. This refers to export, import deliveries, as well as transshipment of freightage from foreign suppliers through Russia to other countries.

Our studies were aimed at developing and introducing a system of preventive measures when transporting

radioactive substances, as well as improving it [4]. The main elements of this system are:

- limits on level of radiation from packages¹ and cars;
- limits on radiation level in cars and number of packages in them;
- limit on activity of radioactive substance per package;
- special specifications for packages;
- mandatory subcritical nuclear freight;
- limit on radioactive contamination of surfaces;
- labeling of packages and conveyances;
- radiation monitoring and quality control.

Concrete hygiene studies were carried out for different forms of radioactive freight, with elaboration of comprehensive preventive measures conforming to specifics of transporting such freight.

In the 1960s-1970s, studies were made of shipment of radioactive ore and concentrates. It was established that in the case of bulk freightage of ore it could be the source of contamination of clothing and hands of railroad workers, railroad car external surfaces and aisles, tracks and installations at departure and arrival stations, and reloading. Urinalysis shows 3-5 times more uranium among railroad workers at such stations than in control groups of such workers (reliability 0.95). Particularly adverse conditions were found when ore is reloaded. As a result of these studies, sanitary rules were published for radioactive ore freightage, special loading and unloading areas were established, safe technologies and sanitary-hygienic measures (respirators, work clothes, decontamination facilities, decontamination of cars and sewage, water and dust suppressers, local ventilation systems, radiation monitoring, reloading uranium in a container or practicing transportation of concentrates instead of ore).

Then in the 1970s-1990s there were successive many-year cycles of hygienic studies of transportation of isotope equipment and radionuclide products, spent nuclear fuel, uranium hexafluoride, chemical uranium concentrates, fresh nuclear fuel, international shipment of radioactive substances, participation in testing new special forms of railroad cars and transport package kits for shipment of the most hazardous radioactive and nuclear materials. Studies were made of dose burdens of railroad workers, passengers, levels of radioactive contamination, gamma and neutron radiation dose rate; the methodology was developed for measuring the risk of shipping such freight; a quantitative evaluation was made of radiation and accident risks in specific directions; hygienically validated methods were offered for

selection of optimum routes; a number of rules, conditions, methodological data, manuals, standards, regulations, instructions were published with the participation of RHI, which were the legal basis for safety and sanitary oversight of conditions of radioactive freightage, as well as measures to prevent and clean up after accidents occurring during such shipments.

The results of applied research made it possible to turn to some theoretical generalizations. They include a system of comprehensive quantitative evaluation of potential and real hazard of freight [3], new classifications of accidents in transit [1, 2], and others.

It should be noted that despite the enormous volume of radiation freightage over the railroad network of the USSR and Russia, there have not been any significant radiation accidents or nuclear incidents during shipment of radioactive substances.

At the same time, the RHI had to participate actively in railroad clean-up after the Chernobyl disaster [5].

At the first stage, the Railroads Ministry, in accordance with RHI recommendations, rapidly validated and organized a system of steps to protect railroad workers within the 30-km zone, it organized radiation monitoring and sanitary oversight in order to detect contaminated and irradiated passengers, as well as contaminated cars and freight, in order to reduce the spread of radioactive substances over the nation. Railroad traffic was promptly stopped over the line passing by the Chernobyl NPP (nuclear power plant), its railroad workers were evacuated, whereas for Block 4 railroad workers in the 30-km zone special protective engine cars were developed, actually tested and installed with the determinative participation of RHI, and it lowered the radiation dose by a factor of 10^3 . At the suggestion of RHI, by order of the Main Sanitary Administration of the Ministry of Railroads, for 1986 the annual dose for railroad workers was set at 0.1 Sv. In early May 1986 the first interim MPL (maximum permissible levels) of radioactive contamination of conveyances were proposed and approved by the USSR Ministry of Health. Safety measures for removal of spent nuclear fuel from the Chernobyl NPP were elaborated and implemented with the participation of RHI, steps were taken to decontaminate railroad equipment, dosimetric monitoring of external (using thermoluminescent dosimeters) and internal (using human radiation counters) irradiation of railroad workers and their families; scientists accompanied mass evacuation of the public, particularly children, from contaminated zones, there was sanitary oversight and laboratory testing of sources of water, food, children's institutions, railroad stations, and subways as places where there was mass concentration of people.

The RHI participated in examining and implementing plans for construction of the Slavutich—NPP railroad line with organization of a transfer point on the boundary of the 30-km zone.

By decision of the Main Sanitary Administration of the Railroads Ministry with consideration of RHI validations, medical-sanitary support of railroads within zones of radioactive contamination was reinforced with additional medical personnel, organization of new radiation hygiene centers at railroad departmental sanitary and epidemiological stations, additional equipment, drugs, and laboratory cars. Subsequently, in the late 1980s and early 1990s, radiation hygiene studies dealing with clean-up of the Chernobyl accident continued. More than 20 methodological directions, instructions, and information letters were published on the results of this work, in which recommendations of practical importance were offered with consideration of the specifics of railroad conveyances: a separate medical dosimetric register of railroad workers harmed by the accident at the Chernobyl NPP was prepared (an element of the Russian national register).

Various prototypes of isotope equipment are used on railroad conveyances. In some cases, specific items of such equipment were developed or used on the railroad, which required their hygienic evaluation and elaboration of railroad rules or instruction for their use or scientific validation for rejecting such proposals. The passenger car smoke detector with americium-241 produced in Czechoslovakia (Tesla firm) and instrument for rapid measurement of undrained residue in tanks (RMURT) with neutron radiation source (manufactured by the Institute of Engineering Physics, Russian Atomic Industry Ministry) are examples of isotope equipment adopted or to be adopted. After thorough analysis for radiation hygiene, relevant rules and instructions were elaborated and put into effect, which regulate all the necessary preventive measures starting with the process of receiving equipment and ending with their write-off and removal as waste under sanitary supervision. Another example is the solution to the problem of using tritium lights for train switches. Studies have shown that the glass bulbs of each light contain more than 10 Ci of this radionuclide which is not resistant to mechanical and climate factors, has no protection against unauthorized actions of third parties and, in a number of instances, could be hazardous when used at railroad stations. Such equipment did not obtain approval and was banned from use. At the present time, the question of using gamma sterilization on a high-activity unit for bedding in passenger cars is under examination. Studies in this direction are continuing.

Railroad civil defense is of national importance. During the Great Patriotic War, more than 70 percent of enemy air raids were aimed at railroad junctions, bridges and other railroad targets. For this reason, a cycle of studies was carried out to predict the possible medical-sanitary situation on the railroad and in subways if modern weapons of mass destruction are used and to elaborate preventive measures that must be planned in advance. The radiation hygiene aspects of railroad civil defense were studied in the direction of protection of people, optimization of preventive medical, sanitary and hygienic measures, decontamination of conveyances and on-board drinking water.

When shipping radioactive substances, working in the presence of radioactive contamination of the area, railroad workers and escort personnel in engines and railroad cars are exposed to the combined effect of radiation and the noise-vibration factor (NVF), while engine teams are exposed nonuniformly. Radiobiological studies of mice, rats, guinea pigs and rabbits were carried out to shed light on these features. The effect of NVF was studied in combinations with acute radiation factors (ARF), as well as chronic irradiation. Some interesting facts were established that are of scientific and practical importance. Exposure to NVF prior to ARF does not aggravate the radiation lesion, and in some combinations could even have a mild protective effect. The effect of exposure to NVF after ARF, when moderate, severe or extremely severe acute radiation sickness develops, could aggravate the deleterious effect of radiation, especially when the NVF is present at the height of acute radiation sickness. Chronic exposure to low doses of radiation and NVF did not reveal reliable evidence of aggravation of the radiation effect on the body as a whole, but it was established that the NVF could have various effects on different physiological and hematological indicators.

Radiation hygiene evaluation of the proposed route is needed when building railroad and subway lines. If this is not done, one cannot rule out the possibility that tunnels or tracks will pass through areas with a high natural radiation background. Thus, construction of one two-way tunnel 8 km long was found to be in the zone of a geochemical province with high uranium and radium content. This was established after the tunneling had begun. Comprehensive studies revealed that in this case radon emanating from the abundant ground water flowing into the entry face through cracks in rock ore presented the main source of radiation hazard. It was proposed to fill the cracks, line the excavated parts of the tunnel with water-proofed concrete, then line new sections of the tunnel with concrete right after they are excavated. As a result of adopting

these recommendations, it was possible to virtually dry the tunnel at the project site and lower the radon concentration to 0.1-0.6 MPC [maximum permissible concentration].

One of the most important issues in RHI radiation hygiene work is to optimize sanitary oversight on the railroads in this respect. Ultimately there was elaboration and substantiation of standards work force size and equipment, dozens of seminars were held with TsSEN physicians, and practical assistance was provided in resolving the numerous most difficult and irregular situations in the railroad network.

Conclusions

1. Railroad radiation hygiene was formed in the last decades; it is an important direction with its own range of problems and methodological approaches of practical and scientific importance.
2. Radiation hazard situations are constantly expanding on railroads, which require concrete hygienic studies and development of preventive measures.
3. Applied research in radiation hygiene is the basis for expounding a number of theoretical theses.

Footnote

1. Package (radiation package) consists of the container and radioactive contents.

References

1. Korshunov, Yu. N., Bazaryan, A. G., Freyman, E. S., and Tsvetkova, L. I., "Sovremennyye problemy diagnostiki, kliniki i lecheniya v transportnoy meditsine" [Current Problems of Diagnosis, Symptomatology and Treatment in Transportation Medicine], Moscow, 1989, pp 27-30.
2. "Main Rules for Safety and Physical Protection During Shipment of Nuclear Materials (OPBZ-83) (USSR Ministry of Railroads," "Sbornik pravil perevozok i tarifov" [Collection of Rules for Shipping and Rates], No 335, Moscow, 1987.
3. Freyman, E. S., Suvorov, S. V., and Boyarchuk, I. P., "Ogizyena, fiziologiya i epidemiologiya na zheleznodorozhnom transporte" [Hygiene, Physiology and Epidemiology Aboard Railroad Conveyances], Moscow, 1977, No 59, pp 31-34.
4. Freyman, E. S., Shupanovskiy, V. D., and Kaloshin, V. M., "Osnovy bezopasnosti perevozok radioaktivnykh veshchestv" [Bases for Safety of Shipment of Radioactive Substances], 2d ed., Moscow, 1986.

S. Freyman, E. S. Kazmin, G. Yu. Romanov, V. V., et al., "Aktualnye voprosy gigieny i ekologii transporta" [Current Problems of Transportation Hygiene and Ecology], Ilyichevsk, 1992, pp 42-45.

Ukraine: Catalytic Properties of Cholinesterases Immobilized in N-Phthalylchitosane and Gelatin

964D0531A Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian
Vol 67 No 5, Sep-Oct 95 pp 49-54

[Article by L.P. Kuznetsova and Ye.B. Nikolskaya, Evolution, Physiology and Biochemistry Institute imeni I.M. Sechenov, Russian Academy of Sciences, St. Petersburg (manuscript received 6 Dec 94); UDC 577.15.086:577.152.31]

[FBIS Summary] A comparative study was made of the catalytic properties of human blood erythrocyte acetylcholinesterase, horse blood serum butyrylcholinesterase and squid cholinesterase immobilized and not immobilized in N-phthalylchitosane and in gelatin. Immobilization of cholinesterases in N-phthalylchitosane does not change its catalytic properties with respect to substrates and inhibitors, but it increases enzyme stability. Cholinesterase immobilization in the gelatin membrane increases the Michaelis constants and decreases the maximum rates in the reaction of enzyme hydrolysis of thiocoline esters and (for squid cholinesterase) of indophenylacetate. The effect of the irreversible inhibitor diisopropylfluorophosphate and the reversible inhibitors N-methyl-4-piperidyl benzyrate and tacrine on cholinesterases immobilized in the gelatin is weaker in comparison with the effect on nonimmobilized enzymes. The results are discussed relative to the effect of immobilization on an active enzyme surface. The research revealed that the immobilization of acetylcholinesterase, butyrylcholinesterase and squid cholinesterase in N-phthalylchitosane increases the stability of these enzymes without changing their kinetic parameters. Immobilization in gelatin also increases the stability of cholinesterases, but in this case changes their substrate-inhibitor specificity. This is consistent with the results of earlier findings by the authors (UKRAINSKIY BIOKHMICHESKIY ZHURNAL 62, No. 6, pp 42-48, 1990). In the structure of the gelatin membrane there is evidently a change in the accessibility of the anion sector of the catalytic center of the cholinesterases and the role of its hydrophobic surroundings. The latter is essentially dependent on the nature of the cholinesterase. Immobilization in N-phthalylchitosane can be recommended for stabilization of cholinesterases when they are used for analytic purposes. This is particularly important for squid cholinesterase, the poor stability of which during storage and use is an obstacle to the use of this enzyme for analytic purposes. References 10: 9 Russian, 1 Western.

Ukraine: Physicochemical Similarity of Neurotransmitter Receptor, Transporter Transmembrane Domains

964D0531B Kiev UKRAINSKIY BIOKHMICHESKIY ZHURNAL in Russian
Vol 67 No 5, Sep-Oct 95 pp 65-71

[Article by G.N. Batrak, S.E. Mogilevich, I.V. Radchenko, and A.I. Luik, Biorganic Chemistry and Petroleum Chemistry Institute, Ukrainian National Academy of Sciences, Kiev (manuscript received 12 Jan 91); UDC 577.1]

[FBIS Summary] Similarity with respect to ligand binding ability of receptors and transporters of neurotransmitters makes it possible to consider them to possess sites of similar structure and physicochemical characteristics. Direct analysis of amino acid sequences alignment did not make it possible to detect such sites. For functionally similar proteins that differ in primary structure, the extent of similarity is satisfactorily assessed on the basis of the physicochemical properties of individual domains. An analysis was made of the transmembrane domains of a set of receptors and transporters of choline, norepinephrine, dopamine and serotonin. In an analysis in the direction from the extracellular to the intracellular border the amino acid sequences of transmembrane domains were divided into fragments, each consisting of 4 amino acids. Each fragment was characterized by physicochemical properties such as hydrophilicity, hydrophobicity, polarity, etc. Hierarchical cluster analysis was performed in the space of the physicochemical properties of these fragments. As a result it was possible to obtain both heterogeneous clusters which contained receptor and transporter fragments and homogeneous clusters which contained only receptor or transporter domains. An analysis of the heterogeneous clusters revealed that the 4th, 5th and 6th transmembrane receptor domains and the 2d, 3d and 7th transmembrane transporter helices are characterized by the maximum similarity. The results lead to the conclusion that these domains participate in the formation of ligand-binding centers. Figure 1; references: 16 Western.

Russia: Ratio of Neuromediator Amino Acids in Comparative Analysis of Stress Protector Effects of δ -Sleep-Inducing Peptide and Piracetam

964D0619A Moscow VOPROSY MEDITSINSKOY KHIMII in Russian Vol 41 No 5, Sep-Oct 95 pp 16-19

[Article by A. M. Mendzheritskiy, N. I. Uskova, A. V. Lysenko, A. E. Matsionis, Ye. A. Sametskiy, Rostov-On-Don State University; (manuscript received 19 Sep 94) UDC 615.31:571.112.6].015.4.07]

[FBIS Summary] Regulatory peptides are of great interest to correct central nervous system disorders caused by extreme environmental factors and pathological conditions. Delta-sleep-inducing peptide (DSIP) is a powerful

adaptogen which increases resistance to various stressors (cold, hypoxia, hyperoxia). DSIP has been shown to balance brain neuromediators under stress conditions. DSIP's activity is enhanced by combined administration with piracetam. This paper clarifies the molecular mechanisms of the participation of DSIP and piracetam in adaptation processes in combined use in brain metabolism correction under extreme conditions. Brain levels of GABA, glutamic, and aspartic acids and the activity of glutaminedecarboxylases were determined in lab animals given DSIP and piracetam separately and together and subjected to stressful conditions. DSIP alone altered neurons and synapses activating the nuclear protein-synthesizing energy formations of nerve cells. Piracetam increased GABA concentration and decreased glutamate concentration. The concentration of aspartic acid increased sharply (70 percent). Piracetam caused the same cellular alterations as DSIP. Taken together, the drugs substantially increased GABA levels and decreased glutamic acid levels. The activity of glutaminedecarboxylases was enhanced. Combined, the substances activate the axosomatic synapses. There is significant activation of inhibitory processes and reduction of excitative processes. Joint administration stabilized the balance of inhibitory and excitatory neurotransmitters. Figures 3; references 11 (Russian).

Russia: Effect of Tetrapeptide Tuftsin on the Activity of Brain Monaminergic Systems Under Experimental Pathology Conditions

964D06198 Moscow VOPROSY MEDITSINSKOY KHIMII in Russian Vol 41 No 5, Sep-Oct 95 pp 23-25

[Article by Ye. L. Dovedova, M. Yu. Monakov, Brain Scientific Research Institute, Russian Academy of Medical Sciences, Moscow; (manuscript received 22 Jul 94) UDC 616.831-092.9-02:615.214.31/-07]

[FBIS Summary] Tuftsin (Thr-Lys-Pro-Arg, 300 µg/kg) stimulates emotional and behavioral responses and is an antidepressant. It acts peripherally and centrally; the molecular mechanisms of its central activity remain unclear. Tuftsin has been found to influence the catecholaminergic systems, in particular, the activity of the tyrosine hydroxylase striatum. Administration of haloperidol induces bradykinesia similar to parkinsonism. Experimental animals were administered haloperidol for an extended period of time. The effect of tuftsin on the state of neuromediator systems was studied by examining the content of monamines, their metabolites, and the enzymatic activity of individual brain formations on a cellular level. Some experiments used a short exposure to neuroleptic. Prolonged administration of haloperidol caused shifts in brain neuromediator systems, including increased MAO A activity, decreased MAO B activity, increased end products of serotonin exchange, and a decrease in cate-

cholamines. A single administration of tuftsin led to changes directed toward normalization of neuromediator levels and activation of the enzymatic system (activation of MAO B, decreased MAO A). Haloperidol may decrease depolarization-dependent capture of Ca^{2+} by brain synaptosomes in the cortex and neostriatum and this is restored by tuftsin. Increased MAO B levels indicates activation of the dopamine system. Tuftsin compensates for reserpine-induced depletion of catecholamines. Administration of tuftsin was marked by a suppression of serotonin use. Tuftsin may selectively modulate metabolism of biologically active substances in subcellular brain structures. Figure 1; tables 2; references 15; 12 Russian, 3 Western.

Russia: Choice of Active Hydrocarbon-Destroying Microorganism for Cleanup of Oil-Contaminated Soils

964D0621A Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 31 No 5, Sep-Oct 95 pp 534-539

[Article by Ye. V. Stabnikova, M. V. Selezneva and O. N. Reva, Kiev State University for Food Technologies, and V. N. Ivanov, Microbiology and Virology Institute, Ukrainian Academy of Sciences; (manuscript received 8 Mar 94) UDC 631.461]

[FBIS Summary] A theoretical and experimental search was made for an active microorganism which would be a destroyer of hydrocarbons and which therefore could be used in the cleanup of soils contaminated by oil and petroleum products. Among the 103 studied strains of spore-forming aerobic bacteria of the genus *Bacillus* (all of which are listed and evaluated) it was possible to select the nine most active destructive agents. These nine selected strains were tested to determine their capacity for growth on media with wet oil. The two best candidates were *B. subtilis* D1 and *B. megaterium* 1BD. The selected strain, *B. megaterium* 1BD, was capable of processing a broad range of hydrocarbons, including aromatic and polycyclic compounds. A bioemulsifier was formed when it was cultivated on a medium with n-paraffins (glucose and diesel fuel also were tested). It was characterized by a high viability, was nonpathogenic and nontoxic. The physiologic characteristics of the strain also were studied when grown in media containing hydrocarbons. For this bacillus there is a complete correspondence to the requirements imposed on microbial components of biopreparations for the clearing of contaminants from soils. The culture also is capable of spore formation, which favors its viability under natural conditions. Figures 3; references 15; 13 Russian, 2 Western.

Russia: Use of Polymerase Chain Reaction for Identification of *Clostridium botulinum* A in Foodstuffs

964D0621B Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian
Vol 31 No 3, Sep-Oct 95 pp 565-570

[Article by O. V. Shlyapnikova, I. S. Kandobina, A. N. Yefimenko and Yu. V. Vertuyev, Epidemiology and Microbiology Institute imeni N. F. Gamaleya, Russian Academy of Medical Sciences; (manuscript received 6 Jun 94) UDC 579.852.13:543.9]

[FBIS Summary] An attempt was made to determine the maximum dilutions of contaminated foodstuffs which would make it possible to identify the presence of the botulinum toxin or *C. botulinum* A. Using PCR (polymerase chain reaction) it was possible to identify each of the studied strains in dilutions equal to those which also made it possible to determine the botulinum toxin (botulinum toxins are the most powerful of those known in nature). It was found that PCR makes it possible to identify *C. botulinum* A in those dilutions of an infected product which exhibit toxicity for mice, although the test must be used with caution because certain foods may contain substances which inhibit the polymerase reaction. The PCR method therefore must not be used independently in the analysis of foodstuffs, but in tandem with the biologic neutralization method in mice and microbiologic analysis. The differences in the sensitivity of PCR for 1- and 2-day cultures of *C. botulinum* A of 2-3 orders of magnitude can be attributed to the fact that in this case in the reaction use is made of the DNA setfree from the cells as a result of their lysis because the culture was added to the PCR reaction mixture without preliminary processing. As the culture ages there is an increase in the number of lysed cells and therefore an increase in the concentration of accessible DNA in solution. This results in an increase in PCR sensitivity. References: 9 Western.

Ukraine: Caldesmon: Ca^{2+} Regulatory Protein Component of Native Thin Filaments of Aorta Smooth Muscle

964D0622A Kiev BIOPOLIMERY I KLETKA in Russian Vol 11 No 3, Sep-Oct 95 pp 28-36

[Article by V. M. Dasilova, N. V. Kulikova, V. S. Tregubov, V. S. Omelyanyuk, A. M. Filenko, Scientific Research Institute of Physiology, Taras Shevchenko Kiev University; (manuscript received 23 Mar 95) UDC 591.175.4]

[FBIS Summary] This paper describes a method of isolating and purifying caldesmon (a calmodulin- and actin-binding protein) from pig aorta smooth muscle.

Caldesmon is a thin filament component which prevents the interaction of myosin with actin, thus inhibiting Mg^{2+} -ATPase activity of reconstructed actomyosin independent of the Ca^{2+} concentration. Tropomyosin seems to enhance this effect. The inhibiting effect of caldesmon is eliminated when calmodulin is added in the presence of Ca^{2+} . In the absence of Ca^{2+} caldesmon interacts continuously with actin, blocking its interaction with myosin. Electrophoretic study of aorta thin filaments are discussed. Spectrofluorometry showed that calmodulin can bind with caldesmon, causing a conformational change in the structure of the latter. The results and literature data indicate that caldesmon is a potential regulator of the actomyosin system in the smooth muscle of vessels. Figures 6; references 39: 6 Russian, 33 Western.

On the Situation With the Death Rate of the Population in the Russian Federation

964D0696 Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian
No 5, Sep-Oct 95 pp 33-35

[Article by B.P. Bruy; (manuscript received 23 Nov 94) UDC 312.2(470)]

[FBIS Translated Text] The noticeably progressive increase in the death rate among the population (Table 1) has become, together with the birthrate dropoff, the most substantial unfavorable manifestation in the demographic development of Russia during recent years.

During 1993, the number of deaths in the country increased in comparison with 1987 by 597,700 persons, or by 39 percent, and in comparison with 1992 by 321,900 persons, or by 19 percent.

A natural loss of population, for the first time observed in the Russian Federation late in 1991, during the past year was 750,300 persons. The number of deaths was greater by a factor of 1.5 than the number of births. By early 1994, the death rate exceeded the birth rate in 69 Russian regions, where 93 percent of the population in the country lived (during 1992 this was observed in 43 territories; during 1991, in 30; during 1990, in 21; during 1989, in 11; during 1988, in 5; during 1987, in 3). In a number of territories of the Northwestern, Central and Central Chernozem regions (including in St. Petersburg and Moscow), the number of deaths exceeded the number of births by a factor of 2.6-2.0.

Whereas when the 1960s passed into the 1990s the death rate of the population of Russia was at the mean European level, it has now increased to the highest level among the well-developed countries of Europe.

One of the factors involved in the general death rate increase in the country is the process of aging of the population. The multiyear reduction in the level of natural reproduction, with each new generation of newborns being numerically smaller than the generation of their parents, has made this process virtually irreversible, and the dropoff in the birthrate has still more accentuated it. According to international criteria, the population of Russia has been considered old even from the late 1960s. However, by the beginning of 1994 there were 29.7 million people of retirement age in the country and their percentage in the population was 20.1 percent; that is, 3 million or 11.1 percent more than early in 1988. It is not by chance that in Pskov, Tver, Novgorod, Tula, Voronezh, Tambov, Yaroslavl, Ryazan, Ivanovo, and Kursk Oblasts, where the percentage of inhabitants at an age older than the able-bodied category is 24-27 percent, the highest death rates in Russia were registered: 17-20 deaths per 1,000.

The long-term nature and stability of the negative trends in the death rate also have been governed to a great extent by the archaic character of the structure of reasons for mortality, the dynamics of which since the mid-1960's has been determined for the most part by an increase in the number of deaths among those of increasingly younger ages from diseases of the circulatory system, as well as those perishing from accidents and poisonings. In the well-developed Western European countries, in contrast to Russia and other states, republics of the former USSR, during this period there was a slow, but progressive decrease in premature mortality in the population.

Radical transformation of all spheres of socioeconomic and social development of Russia accentuated still more the problem of a high mortality of the population from the indicated and many other causes (Table 2).

During the late 1980s to early 1990s there was an appreciable decrease in the average age of onset of death. For example, from diseases of the respiratory organs it decreased during 1990-1993 from 66.8 to 61.6 years (by 5.4 years), from diseases of digestive organs — from 65.8 to 60.9 years (by 4.9 years) and from diseases of the circulatory system — from 75.6 to 72.3 years (by 3.3 years). To a great extent this is associated with an intensive increase in the age-group death rate (Table 3).

The increase in the overall level of mortality during 1988-1993 was virtually two-thirds attributable to the increasing number of deaths among those in the able-bodied age group. During the past year 620,800 Russians in the able-bodied age range died from different diseases, accidents and poisonings — this was 29

percent of all the deaths versus 25-26 percent in the late 1980's. During the last six years the death rate for the able-bodied population in Kamchatka, Murmansk, Vologda, Sakhalin, Chita, Irkutsk, and Amur Oblasts, Komi Republic, Primorye Krai, St. Petersburg, and Moscow increased by a factor of 2.3-3.0 (the average for the country as a whole is 1.7).

In the structure of the causes of mortality among able-bodied persons the first place is occupied by accidents and poisonings. Among males these are the cause of death of every second person dying in this age group, but among women — every third. During 1993 a total of 261,500 able-bodied Russians died of unnatural causes (75 percent of the total number dying from these causes) — greater than in 1992 by a factor of 1.3 and greater than in 1988 by a factor of 2.2.

The death rate of males in the able-bodied age group exceeds the death rate of women by a factor of four (116 of each 10,000 males in this age group died in 1993, 28 women of each 10,000): from diseases of the respiratory organs — by a factor of six, diseases of the circulatory system, accidents and poisonings — by a factor of five. With future persistence of the current age-group level of mortality about 44 percent of the present-day generation of 16-year-old youths will not live to age 60, and in rural areas of the Tuvan and Khakassian Republics, Leningrad, Novgorod, Pskov, Vladimir, Tver, Tula, Kemerovo, Irkutsk, and Amur Oblasts — 50 percent.

It must be noted that in the Western European countries, United States and Japan the level of premature deaths among able-bodied males is less by a factor of 2.5-4.0 than in Russia.

The lag behind the well-developed countries of the world with respect to the level of child mortality is increasing. Its index in the Russian Federation in the early 1990s again began to increase: during 1990 17 of every 1,000 newborns died without surviving to age one, during 1991-1992 — 18, and during 1993 — 20 (in the Western European countries, United States and Japan — every 5-10). In part this is attributable to Russia changing over, beginning on 1 January 1993, to the criteria recommended by the WHO for still and live births. However, to an equal degree (approximately 50-50) the increase in the child death rate is attributable to worsening of the situation with diseases characteristic for the newborn in the age group from one month to one year.

The dynamics of the death rate during recent years is evidence of a considerable worsening of health of the population in the country. Its level, like demographic processes, is determined to a great extent by the

consequences of the cataclysms of the 20th century — world and civil wars, starvation, political repressions and ecological catastrophes.

Unfavorable changes in the health of Russians began to increase significantly beginning in the 1960s. After the successes attained in the struggle against infectious diseases, the centralized state public health system in Russia and in the other republics of the former USSR more and more began to exhibit its ineffectiveness applicable to the predominance of diseases of an endogenous character prevailing at that time, that is, to diseases of the circulatory system, endocrinal system, tumors, etc. The simple coverage of the population with medical services without a radical improvement in its quality and the broad introduction of new medical technologies into practical work could not ensure subsequent progress. Under the conditions of recent socioeconomic changes the task of preserving the health of the population was aggravated to a still greater degree. The decrease in the standard of living, inevitable with adaptation of the population to a market economy, under conditions of an unsatisfactory status of basic medicine,

a shortage of medicines, inadequate compensation for the worsening natural and social sphere, predetermined further slippage in the health of Russians.

During 1993 there were 97 million cases of affliction with acute and chronic diseases in the country with a diagnosis being made for the first time. A stable tendency to an increase is observed for the majority of groups of diseases, with the greatest increase being for diseases of the blood and blood-generating organs (in comparison with 1990 by a factor of 1.7), congenital anomalies (amounting to 30 percent), diseases of the endocrinal system (by 25 percent), diseases of the genito-urinary system (by 23 percent), psychic disorders and diseases of digestive organs (by 19 percent), diseases of the nervous systems and organs of sense (by 18 percent). All this is occurring against a background of a reduction in the number of hospital beds (by 7 percent in comparison with 1990) and walk-in and polyclinic facilities (amounting to 5 percent). The number of visits to doctors and the number of those receiving treatment in hospitals is dropping.

Table 1. Dynamics of Mortality of Russian Population 1987-1993

Year	Number of deaths		
	Thousands of persons	Per 1,000	Deaths per 1,000, Percent of preceding year
1987	1,531.6	10.5	101.0
1988	1,568.1	10.7	101.9
1989	1,543.8	10.7	100.0
1990	1,656.0	11.2	104.7
1991	1,890.7	11.4	101.8
1992	1,807.4	12.2	107.0
1993	2,129.3	14.5	118.9

Sanitary-epidemiological conditions worsened in most regions of the country. There was an increase in the incidence of syphilis by a factor of six and of gonorrhea by a factor of 1.8. The detectability of the infection sources decreased by more than half. Due to delayed detection of the disease, the number of patients with both an active and a neglected form of tuberculosis increased by 25 percent in comparison with 1990.

During 1993, 12.7 million cases of poisonings were registered, which is 357,000 (3 percent) more than in 1992 and 1 million (7 percent) more than in 1987.

An aggravation of the crime situation and a weakening of work discipline favored an increase in the occurrence of everyday and industrial trauma. A high accident rate also was attributable to the widespread occurrence of drunkenness and alcoholism. During 1993 alone, chronic alcoholism and alcoholic psychoses were detected in 145,400 persons (40 percent more than in 1992), including alcoholic psychoses in 32,100 persons (accordingly, greater by a factor of 2.4).

According to estimates of WHO specialists, up to 30 percent of the diseases among the population of the

planet are associated with environmental pollution. In this connection it must be noted that almost half of Russians, according to information from the Russian Federation State Committee for Sanitary and Epidemiological Oversight, drink water not meeting hygienic standards. According to data from the Russian Federation Ministry

of Environmental Protection and Natural Resources, levels exceeding the MAC of one type or several contaminating substances is noted in the air of 171 cities, and in 83 of them the maximum one-time concentrations of individual harmful substances were 10 times greater than the maximum admissible levels.

Table 2. Factors Governing Death Rate in Russia

Index	Number of Deaths, 1993			1993 Relative to 1987	Percent of 1993
	Total, thousands	Percent of total number of deaths	Number of Deaths Per 100,000		
Total dying from all causes	2,129.3	100.0	1,446.4	137.8	119.0
Including:					
from circulatory system diseases	1,131.9	53.2	768.9	126.9	119.0
from tumors	304.5	14.3	206.9	114.3	102.5
from accidents, poisonings and traumas	335.6	15.8	227.9	By factor of 2.3	131.7
among them:					
from alcohol poisonings	45.4	2.1	30.9	By factor of 3.9	By factor of 1.8
from suicides	56.1	2.6	38.1	By factor of 1.6	122.9
from murders	45.1	2.1	30.6	By factor of 3.9	134.2
from highway accidents	45.4	2.1	30.8	By factor of 1.8	102.0
from diseases of respiratory organs	109.6	5.1	74.5	119.4	128.7
from diseases of digestive organs	56.3	2.6	38.3	138.8	116.8
from infectious and parasitic diseases	25.5	1.2	17.3	125.4	132.1

Table 3. Dynamics of Age Group Indices of Mortality in Russia 1987-1993

Age, years	Number of deaths per 1,000 population of corresponding age			1990 Percent relative to 1987	1993 Percent relative to 1987	Percent relative to 1990
	1987	1990	1993			
0-14	2.09	1.63	1.49	78.0	71.3	91.4
15-19	0.89	1.13	1.46	127.0	By a factor 1.6	129.2
20-29	1.54	1.89	2.75	122.7	By a factor 1.8	145.5
30-39	2.47	3.10	5.03	125.5	By a factor 2.0	By a factor 1.6
40-49	5.61	5.97	9.88	106.4	By a factor 1.8	By a factor 1.7
50-59	12.03	12.41	17.50	103.2	145.5	141.0
60 and older	49.64	48.68	56.15	98.1	113.1	115.3
Died while able-bodied	4.36	4.88	7.41	112	By factor 1.7	By factor 1.5

The health and the level of mortality of the population are adequately reflected in the life expectancy index. The figure reached 70 years for the first time during 1986-1987 (including 65 for males and 75 for females); it subsequently began to decrease and in 1993 was 65 (59 for men, 72 for women). In not a single well-developed country is there such a difference in the life expectancy of males and females; in the Western European countries the anticipated life expectancy of males is on the average 12 years higher than the mean for Russia, and for females it is seven years higher. In the rural areas of the Karelian, Altay, Tuvan, and Khakassian Republics, Yevreyskaya (Jewish) Autonomous Oblast, Leningrad, Novogorod, Pskov, Tver, Tula, and Kemerovo Oblasts, the life expectancy of males is less than 55 years.

A reduction by half in the number of deaths from unnatural causes and a decrease in child mortality to its level in the well-developed countries would mean an annual preservation of the life of about 200,000 persons

and would increase the anticipated life expectancy of Russians by not less than four years."

During 1994, the unfavorable changes in mortality continued. Taking the prevailing trends into account, it can be assumed that the total number of deaths by the end of the year will increase by an additional 188,000 persons, or by 8 percent, and will be 2.3 million persons (that is, 15.8 deaths per 1,000 persons). It is expected that the mortality from infectious and parasitic diseases will increase by 13 percent, from diseases of the circulatory system by 10 percent, from accidents and poisonings by 8 percent, including by alcohol poisonings — by 20 percent.

Since the birth rate for the time being is persisting at the level of the past year, the increase in mortality is resulting in a further increase in the natural loss of population up to 950,000 persons, and the number of dying exceeds the number of those being born by a factor of 1.7.

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